



CENTER of
EXCELLENCE

Research to Standards

EXO TECHNOLOGY

ASTM INTERNATIONAL
Exo Technology Center of Excellence

ANNUAL REPORT 2021/2022

www.etcoe.org



WELCOME

The ASTM International Exo Technology Center of Excellence (ET CoE) is uniquely positioned within ASTM to improve quality of life and participation of all people through the acceleration of exo technology research, standards, testing, and training. Building on the expertise and knowledge of ASTM's 125 history of helping the world work, the ET CoE empowers people around the globe to safely use and implement exo technologies.

Through collaborations with likeminded organizations and a growing network of partners the ET CoE:

- anticipates the future of technology;
- explores what work and life will look like beyond tomorrow; and
- shares knowledge and insights with the global community.

Since its launch in 2019, the center has continued to grow and mature, and this past year was exciting and full of progress. This progress is due to the hard work of numerous ASTM members, partners, ASTM staff, and collaborating organizations that are helping to move the ET CoE toward a shared vision.

On the following pages of this report, you'll find detailed information on the Center's scope, team, partners, current projects, accomplishments, and important milestones from the past year, including:

- Since 2019, the Center and our partners have generated more than \$500K in new knowledge for the exoskeleton community
- Center-funded research to standards projects have produced eight new work items and one new standard;
- ASTM International's UAE Chapter held a workshop on exoskeletons for construction that brought together leading experts in exo technology and robotics who discussed this emerging industry and standards from ASTM's exoskeletons and exosuits committee;

- The Center sponsored the exoskeletons track at the HFES 8th ErgoX Symposium in Atlanta Georgia. The symposium delivered the latest research in the areas of exoskeletons, cybersecurity, robotics, and extended reality;
- Bill Billotte, executive director, ET CoE, and Nora Nimmerichter, ASTM International staff manager, hosted the Excellent Exo Chat podcast, producing 37 episodes this past year covering exoskeletons, robotics, and emerging technology; and
- ASTM International and U.S. Army DECVOM Soldier Center hosted a panel discussion in May discussing exoskeletons, the difference between powered and non-powered exos, selecting the right exoskeleton for a given task, and much more.

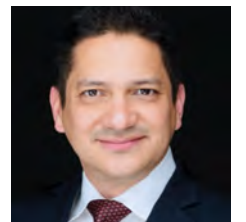
The ET CoE team is thankful to be a part of the exo community, proud of the work the center has accomplished over the past year, and excited by the opportunities yet to come. We hope you enjoy the updates on the pages ahead.



William "Bill" Billotte, Ph.D.
ET CoE Executive Director,
ASTM International



Katharine E. Morgan
President,
ASTM International



Cesar A. Constantino, Ph.D.
2022 ASTM International
Chair of the Board

CONTENTS

02

OVERVIEW

04

PARTNERS

10

RESEARCH-TO-STANDARDS PROJECT(S)

14

EDUCATION & WORKFORCE DEVELOPMENT

16

ACCOMPLISHMENTS & METRICS

18

LEADERSHIP



OVERVIEW

Committed to serving global societal needs, ASTM International positively impacts public health and safety, consumer confidence, and overall quality of life. We integrate consensus standards – developed with our international membership of volunteer technical experts – and innovative services to improve lives... Helping our world work better.

ASTM International’s Exo Technology Center of Excellence (ET CoE) brings together industry, healthcare, academia, and government to accelerate safety, performance, and reliability standards for exoskeletons and their systems. Through research-to-standards (R2S), knowledge sharing, and education efforts, the ET CoE aims to ensure safety and build confidence in this technology.

Our vision is for people of all ages able to pursue a high-quality of life and fully participate in work and society thanks to safe, reliable, and effective exoskeletons. We accelerate exo technology research, standards, testing, training, and workforce development.



WHAT IS AN EXOSKELETON?

Exoskeletons are wearable devices that augment, enable, assist, and/or enhance physical activity through mechanical interaction with the body. **(ASTM F3323)**

Exo technologies combine cutting edge engineering design with emerging technologies (i.e., robotics, artificial intelligence, textiles, and advanced materials) that interface directly with individuals and may collaborate with machines and devices both directly and remotely. From preventing serious injury, to helping complete heavy or constant repetitive tasks, to making it possible for differently-abled children to walk again – exo technologies empower everyday lives.



OUR GOALS

BUILD TRUST AND CONFIDENCE IN THE SAFETY OF EXO TECHNOLOGIES.

CREATE STRONG PARTNERSHIPS ACROSS AND WITHIN DIFFERENT INDUSTRY SECTORS.

CREATE A KNOWLEDGE CENTER THAT SERVES THE EXO COMMUNITY WITH TRAINING AND CERTIFICATION, TECHNICAL EXPERTISE, AND DATA.

PARTNERS

Our partners provide technical and business expertise while connecting the ET CoE to exoskeleton users, developers, and producers. Our partners provide technical expertise along with facilities to conduct outreach, research-to-standards, and education and workforce development. These efforts support the priorities and needs of the exo community.

FOUNDING PARTNERS

EXOSKELETON REPORT LLC



NEW STONE SOUP



PRIME PERFORMANCE LLC



COLLABORATION PARTNERS



Human Factors and Ergonomics Society (HFES)
The Human Factors and Ergonomics Society (HFES), founded in 1957, is the world's largest scientific association for human factors/ergonomics professionals. HFES serves the needs of members and the public by promoting and advancing the discovery and exchange of knowledge concerning the characteristics of human beings that are applicable to the design of systems, products, tools, and environments of all kinds.

Goals of ASTM and HFES partnership:

1. Promote communication between the two organizations,
2. Promote knowledge of the ASTM standards and the benefits of ASTM membership to HFES members,
3. Promote knowledge of HFES and benefits of HFES membership to ASTM members,
4. Increase expert input into the development of ASTM exo technology standards and other areas of common interest from HFES,
5. Pursue safe and reliable exo technologies through awareness and education activities such as workshops, symposia, training events, and



National Safety Council (NSC)
The National Safety Council (NSC) is America's leading nonprofit safety advocate – and has been for over 100 years. As a mission-based organization, it works to eliminate the leading causes of preventable death and

PARTNERS

injury, focusing our efforts on the workplace, roadway and impairment. NSC creates a culture of safety to not only keep people safer at work, but also beyond the workplace so they can live their fullest lives.

Goals of ASTM and NSC partnership:

1. Promote communication between the two organizations;
2. Promote knowledge of the ASTM standards and benefits of ASTM membership to NSC members;
3. Promote knowledge of NSC and benefits of NSC membership to ASTM members;
4. Increase expert input into the development of ASTM exo, robotics, automation, and autonomous system standards and other areas of common interest from NSC; and
5. Pursue safe and reliable exo, robotics, automation and autonomous systems technologies through awareness and education activities such as workshops, symposia, training events, and conferences.



South Carolina Research Authority (SCRA)

Chartered in 1983 by the State of South Carolina as a public, nonprofit corporation,

South Carolina Research Authority (SCRA) fuels South Carolina's innovation economy through the impact of its four programs. SC Academic Innovations (SCAI) provides funding and support to advance multi-institutional, translational research, and accelerate the growth of university-based startups. SC Facilities (SCF) offers high-quality laboratory and administrative workspaces for technology-based startups and academic institutions. SC Industry Solutions (SCIS) facilitates and funds partnerships between and among startups, industry, and academia. SC Launch (SCL) mentors and funds technology-based startups that may also receive investments from SCRA's investment affiliate, SC Launch, Inc.



RESEARCH PARTNERS



U.S. National Institute of Occupational Safety and Health (NIOSH)

The Occupational Safety and Health Act of 1970 established NIOSH as a research agency focused on the study of worker safety and health, and empowering employers and workers to create safe and healthy workplaces. NIOSH is part of the U.S. Centers for Disease Control and Prevention, in the U.S. Department of Health and Human Services. NIOSH has the mandate to assure "every man and woman in the nation safe and healthful working conditions and to preserve our human resources." NIOSH has more than 1,300 employees from a diverse set of fields including epidemiology, medicine, nursing, industrial hygiene, safety, psychology, chemistry, statistics, economics, and many branches of engineering.



National Institute of Standards and Technology (NIST)

The National Institute of Standards and Technology (NIST) was founded in 1901 and is now part of the U.S. Department of Commerce. NIST is one of the nation's oldest physical science laboratories. Congress established the agency to remove a major challenge to U.S. industrial competitiveness at the time—a second-rate measurement infrastructure that lagged the capabilities of the United Kingdom, Germany, and other economic rivals.

From the smart electric power grid and electronic health records to atomic clocks, advanced nanomaterials, and computer chips, innumerable products and services

rely in some way on technology, measurement, and standards provided by the National Institute of Standards and Technology.

Today, NIST measurements support the smallest of technologies to the largest and most complex of human-made creations—from nanoscale devices so tiny that tens of thousands can fit on the end of a single human hair up to earthquake-resistant skyscrapers and global communication networks.

Smart HLP

Smart HLP

Roger Bostelman, Ph.D. formed Smart HLP LLC in 2018 to contract to government and other organizations upon retiring from the U.S. National Institute of Standards and Technology (NIST). Currently, Smart HLP is an ET CoE Research Partner assisting with Research-to-Standards projects.



SwiftMotion

SwiftMotion is an innovative company based in the San Francisco Bay Area, California which focuses on developing products for the improvement of occupational health. The company was founded by a team of experienced engineers from places such as Apple and is advised by some of the leading experts in the field of ergonomics and occupational health.

The team has developed standards for mobile telecommunications, smartphone industry, focusing on smartphone performance measurements, testing of phones and for the safety of end users. The team has participated in several industry standards bodies meetings such as the 3rd Generation Partnership Project (3GPP) as well as the Cellular Technologies Industries Association (CTIA).



University of Michigan – Dearborn

The University of Michigan is a top-ranked public university with a tradition of excellence in research, learning, and teaching. Dearborn is one of the three regent campuses of the University of Michigan. Slightly different from Ann Arbor's theoretical and fundamental research focus, the Dearborn campus mainly promotes applied research that has clear application potential in the field. With grants and financial support received from industry and government agencies, Dearborn faculty conduct transdisciplinary, translational, and transactional research that could have specific applications and direct impacts in multiple research fields. The University of Michigan - Dearborn has two human factors and ergonomics research laboratories (HPEC 1000 and ELB 3042) and one vehicle ergonomics laboratory (IAVS 1080).



Virginia Tech

As the Commonwealth of Virginia's most comprehensive university and a leading research institution, Virginia Tech offers about 280 undergraduate and graduate degree programs to more than 37,000 undergraduate, graduate, and professional students and manages a research portfolio of more than \$556 million. The university fulfills its role as a land-grant institution by fostering a collaborative environment that integrates technology into all disciplines. The Virginia Tech community can serve as a force for positive change around the state, the country, and the world. Through experiential learning, future-focused research, and an inclusive, spirited culture, Virginia Tech strives to accomplish the charge of its motto *Ut Prosim* (That I May Serve).

PARTNERS

The research team has a strong collaboration with broad areas of expertise and experience involving multiple faculty members from the Department of Industrial and Systems Engineering (ISE). Each of these faculty are members of the Virginia Tech Occupational Ergonomics and Biomechanics (OEB) Laboratories. The OEB Laboratories conduct work in theoretical and applied ergonomics, occupational biomechanics, and work physiology, primarily relating to worksite, workstation, and equipment evaluation and design.



EDUCATION AND WORKFORCE DEVELOPMENT PARTNERS



Automotive Exoskeleton Group (AExG)

AExG is a Wearable Robotics Association sponsored and industry-inclusive group that supports the evolution of exoskeletons for industry. It began with members from the automotive industry but has since expanded to include members from other industries, exoskeleton producers, and other interested stakeholders. Its vision is to promote quality of life through wearable technologies. AExG works create a forum where the exoskeleton community may openly exchange information.



Boston Engineering Corporation

Boston Engineering Corporation (Boston Engineering) provides product design and engineering consulting throughout the entire product development process, from concept through connected product capabilities. Certified for ISO 9001 and ISO 13485, the company's industry expertise includes defense & security, medical devices, robotics, and commercial products. Founded in 1995, Boston Engineering is headquartered in Waltham, Massachusetts. Since 2018, Boston Engineering has been serving as DEVCOM SC's third-party independent engineering analysis agent under an "Other Transaction Authority" agreement from the Army Contracting Command – Aberdeen Proving Grounds (ACC APG).



LiUNA TriFund

The Laborers' International Union of North America (LIUNA) is a powerhouse of workers who help build the United States and Canada. A half-million strong, LiUNA provides the opportunity to earn a living wage, receive benefits, including health care and pensions, and attend life-long education and training for career advancement and better lives. LiUNA members are the first on the job and the last to leave, possessing a wide range of skill sets covering new building construction, demolition and deconstruction, environmental remediation, renewable energy, and all areas of infrastructure, including roads, bridges, dams, and utilities. They are certified to install rainwater catchment systems and trained to build water and sewer systems, solar plants, wind farms, natural gas and oil pipelines, while also performing maintenance and decommissioning of nuclear and coal powered facilities.

Playing a critical role in achieving these opportunities are LIUNA's TRI-Funds: LIUNA Training and Education Fund (LIUNA Training), the Laborers-Employers Cooperation and Education Trust (LECET), and the Laborers' Health and Safety Fund of North America (LHSFNA). Each provide a labor-management approach to training, marketing, and health and safety programs.

LIUNA Training provides accredited curriculum and instructor training, registered apprenticeship, standards development, and portable industry credentials to a North American network of world-class training centers. The LHSFNA ensures workers are safe on the job and at home while providing expertise to ensure the best healthcare benefits in the industry. LECET keeps the vision of labor-management cooperation by providing a competitive edge in tracking work opportunities. The TRI-Funds' goals are to ensure LIUNA's journey-workers and apprentices remain a skilled, safe, and productive experienced union workforce, enabling union contractors to gain more work by bringing projects in on time and on budget.



U.S. Army Combat Capabilities Development Command, Soldier Center (DEVCOM SC)

DEVCOM SC ensures the dominance of Army capabilities by creating, integrating, and delivering technology-enabled solutions to our soldiers. Soldier Center follows a simple mandate: to ensure that American soldiers are the best fed, the best protected, and the most highly mobile military in the world.

The U.S. Army has provided modern Soldiers with greater capability than has existed at any time in the history of warfare. The average soldier's load has doubled since World War II despite efforts to reduce the load, increasing fatigue and musculoskeletal injuries

and decreasing soldier readiness. Soldier speed, endurance, and range all decrease with load, and they are also impacted by the nature of many of the required repetitive motion maneuvers. Until now, there have been limited choices in dealing with the effects of load and motion: Carry the load and accept the negative consequences or go without a critical piece or pieces of the Soldier kit. These choices have consequences that impact the effectiveness of Soldiers and can potentially limit options for commanders. The future will call for warfare for even greater maneuvering in dense urban terrain, subterranean and vertical, and over 72-hour operations carrying only organic supplies, as well as experiencing complex maneuver operations.

The Army is interested in exoskeleton technology to assist in addressing the soldiers' physical and cognitive load challenges to improve their readiness and operational effectiveness. Due to advancements in technology and large investments from industry, exoskeleton technology has the potential to provide a significant advantage for warfighters. Many organizations, including the Program Executive Office Soldier, the Maneuver Center of Excellence, and collaborations with the Special Operations Command, U.S. Navy, and U.S. Air Force are working to investigate and eventually deploy such devices.

RESEARCH-TO-STANDARD(S) PROJECTS



Longitudinal Health Effects of Shoulder Exoskeletons in the Manufacturing Sector

Responsible Partner: NIOSH

A longitudinal design will be adopted to assess the health effects of existing passive shoulder exoskeleton users for repetitive overhead assembly work in a manufacturing setting. Aggregated injury and associated workers' compensation cost information will be collected over a two-year period. A subset of study participants randomly selected from the study cohort will undergo shoulder and back functional assessments at their work sites. The aggregated injury/workers' compensation information and shoulder functional information will be collected by participating companies at three time points: baseline, one-year follow-up, and two-year follow-up.

NIOSH investigators are responsible for recruiting the selected subjects for the shoulder and back functional tests. A NIOSH-funded contractor will conduct the back functional assessment at study sites using the clinical lumbar motion monitor at two time points (baseline and one-year follow-up). Injury and workers' compensation data will be submitted to NIOSH through a website created and managed by ASTM. NIOSH investigators will receive de-identified data that will not be linkable to a specific company or participant. The aggregated injury/workers' compensation information will be analyzed and interpreted by pooling data across multiple sites of multiple participating companies.

In addition, quantitative statistical analyses of the aggregated outcome measures will be performed for

determining statistical differences between the study groups. The study will assess three types of outcomes:

- Number of musculoskeletal injury cases, lost work time, and workers' compensation costs (medical and indemnity) for the cases;
- Identifiable changes in shoulder function; and
- Risk of impaired back function of study participants.

The study data will be made anonymous, and no personal data of the users will be shared. ASTM will collect, house, and manage data submitted from external resources related to safety concerns and injury incidents tied to exoskeleton usage. Some industries participating in this study include aerospace, military, automotive, and manufacturing.

Currently, ASTM has created a secure Sharepoint site for the data and is actively pursuing data usage agreements with the study participants.



System and Method to Perform Job Classification for Return-to-Work Exoskeleton deployment

Responsible Partner: SwiftMotion

A guide on how to use wearable body sensors and ergonomic analysis methods to aid Return to Work decisions using exoskeletons will be developed.

- Measure physical demands of workers returning to work after injury. The study will collect and analyze posture as well as loads handled by workers on job sites.
- Classify jobs based on appropriate thresholds from the sensor data into high- and low-risk categories for specific body parts (shoulder, low back, etc.).



NIST, ASTM International, and University of Massachusetts - Lowell teams at the 2022 Excelsior Challenge in Oriskany, New York.



Metrology for Emerging Technology, Robotics, and Exoskeletons (METRE) intended for Industry and Public Safety

Responsible Partner: NIST

The goal of METRE is to develop a set of user-defined requirements in the application of exoskeletons within the domain of emergency response. The pre-normative research will lead to standard test methods to evaluate performance of exoskeletons in two key areas: the fit and motion of the exoskeleton device with respect to the users' body and the impact that using an exoskeleton has on the performance of users executing tasks that are representative of activities of first responders.



RESEARCH-TO-STANDARD(S) PROJECTS



Investigating Critical Challenges and Potential Solutions Towards Developing Standards to Guide the Proper Use of Exoskeleton for Injured Workers' Return to Work

Responsible Partner: University of Michigan - Dearborn

A guide on how to use advanced digital human modeling techniques and ergonomic analysis methods to aid Return to Work decisions using exoskeletons will be developed.

Expected outcomes from this project:

- Develop a method for the identification of the limitations and benefits of the use of exoskeleton by injured workers.
- Generate a reference chart for a quick fetch of the approximate exoskeleton supports in the sample conditions.
- Identify initial exoskeleton design gaps and needs to accommodate injured workers.
- Design a sample application as an information system, training, and risk management reference for medical providers in the selection and timing for the proper use of exoskeleton.
- Design a sample application as auxiliary training materials for return-to-work exoskeleton users.



Rapid Development of Exoskeleton Test Method Standards

Responsible Partner: Smart HLPR

The following list of standards topics, from ASTM committee on Task Performance and Environmental Considerations (F48.03) Roadmap of Standards to Develop, will be used to guide completed drafts to go to ASTM ready for evaluation and testing.

- **Approved** - Test method for exoskeleton use: gait
- **Approved** - Test method for exoskeleton use: hurdles
- **Approved** - Test method for exoskeleton use: gaps
- **Approved** - Test method for exoskeleton use: obstacle avoidance: Walking
- **WK76431** - Test method for exoskeleton use: stairs
- **WK83509** - Test method for exoskeleton use: crawling

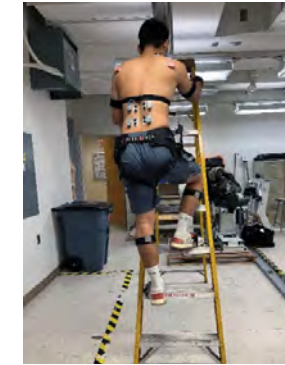


Development of Measurement Protocols for Efficient and Reliable Exoskeleton Testing and Evaluation

Responsible Partner: Virginia Tech

A systematic, lab-based study to support future decisions regarding study protocols (i.e., number of trials and sessions) for a given exoskeleton type and task of interest.

- Reliable and efficient assessments of the effects of exoskeleton use are critical to support the development of testing and evaluation standards and use recommendations.
- Several task types (basic activities, static tasks, and dynamic tasks) are being examined, and a broad set of objective and subjective measures will be obtained, including muscle activation levels, joint kinematics, perceived exertion, and aspects of usability.
- Completing the proposed work will provide important practical information to enable efficient and reliable assessments of EXO use under different task conditions.



Medical Exoskeleton Practitioner Survey

Responsible Partner(s): Founding Partners

The survey, among others, will focus on understanding of the use of medical exoskeletons by healthcare providers, as well as their experiences, and recommendations. This data will help us further understand the trends, lessons learned, and gaps that can support identifying needed education, outreach, research, data, and standards gaps that will help guide the outputs of the ASTM Exo community.

Key Outcomes:

- Understand healthcare provider experiences with exoskeleton technologies;
- Identify the types of products selected;
- Understand the overall experience with patients, their general perceptions, and trends;
- Understand approaches to using exoskeleton products with patients;
- Identify and understand research and information gaps ;
- Communicate findings and design a framework for ASTM committee on Exoskeletons and Exosuits (F48) and the insurance community at large ;
- Understand and communicate current barriers for use;
- Understand and communicate barriers for communication;
- Identify lessons learned to benchmark trends, and
- Compare market segment perceptions with those of producers, where such producer data may exist.

EDUCATION & WORKFORCE DEVELOPMENT



Exoskeleton 101 Panel Discussion DEVCOM SC

DEVCOM SC and ASTM International ET CoE hosted a panel discussion on May 6th regarding what are exoskeletons, the difference between powered and non-powered exos, choosing the right exoskeleton, myths regarding exoskeletons and much more. Over 50 service individuals joined the event from across the Branches of the US Military.



ASTM International Workshop on Exoskeletons for Construction

The ASTM International UAE Chapter held a Workshop on May 11, 2022, at the Heriot-Watt University, Dubai Campus. The Workshop brought together several leading experts in the field of Exo technology and Robotics who discussed this new industry and standards from F48, the ASTM Committee on Exoskeletons and Exosuits.



From left to right: Jim Olshefsky, ASTM International; Amer Bin Ahmed, Knauf; and Bill Billotte, ASTM International in attendance at ASTM International Workshop on Exoskeletons for Construction in Dubai, UAE.

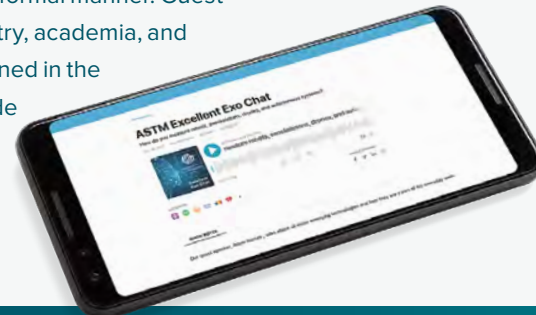
QUARTERLY NEWSLETTERS

Quarterly newsletters were released in March and July, 2022. The purpose of the quarterly newsletter is to provide a snapshot of the efforts of the Center, share updates from the exo community, and highlight Committee F48 on Exoskeletons and Exosuits work item registration and standards approved.



EXCELLENT EXO CHAT – LISTEN NOW!

Hosts, Bill Billotte and Nora Nimmerichter of ASTM International discuss exoskeletons, robotics, and emerging technology. Bill and Nora use the Podcast to increase the awareness of exo and emerging technologies in an informal manner. Guest speakers from industry, academia, and government have joined in the discussions to provide insight into the latest challenges and success of these technologies.



REHACARE 2022

Dusseldorf, Germany - Bill Billotte gave a virtual talk on the Exo Technology Center of Excellence and ASTM's standards efforts. REHACARE is the world's biggest trade fair for rehabilitation and care and has demonstrated with many innovations to touch and try out plus numerous activities in the exhibition halls what the care & rehab growth market has to offer for self-determined living. From 14 – 17 September 2022, 35,000 visitors gathered information on the latest everyday aids and solutions for every disability and every area of life.



ErgoX 2022

The ET CoE sponsored the exoskeleton track at the HFES 8th ErgoX Symposium, October 14- 15, 2022 in Atlanta, GA. ErgoX is designed to showcase and apply the latest ergonomics science to workplace health, safety, wellness, and injury-prevention issues across a variety of domains and settings. This year's Symposium, with the theme Designing Technology for People, delivered the latest research in the areas of Exoskeletons/Exosuits, Cybersecurity, Robotics, and Extended Reality.



NIST, ASTM International, and University of Massachusetts - Lowell teams at the 2022 Excelsior Challenge in Oriskany, New York.



Excelsior Challenge 2022

The New York State Division of Homeland Security and Emergency Services had nearly 150 law enforcement professionals from across the state and Canada take part in cutting-edge training to address active threat scenarios at the Excelsior Challenge, hosted by the State Preparedness Training Center in Oriskany.

The Center partnered with the National Institute of Standards and Technology (NIST) to introduce exoskeletons, robots, and UAV's to the first responders participating in the Excelsior Challenge 2022.

ACCOMPLISHMENTS & METRICS



Founding Partners



Collaboration Partners



Research Partners



Education & Workforce Development Partners



Advisory Board Members



R&D Team



LinkedIn Followers: **600+**
www.linkedin.com/company/exo-technology-center-of-excellence/



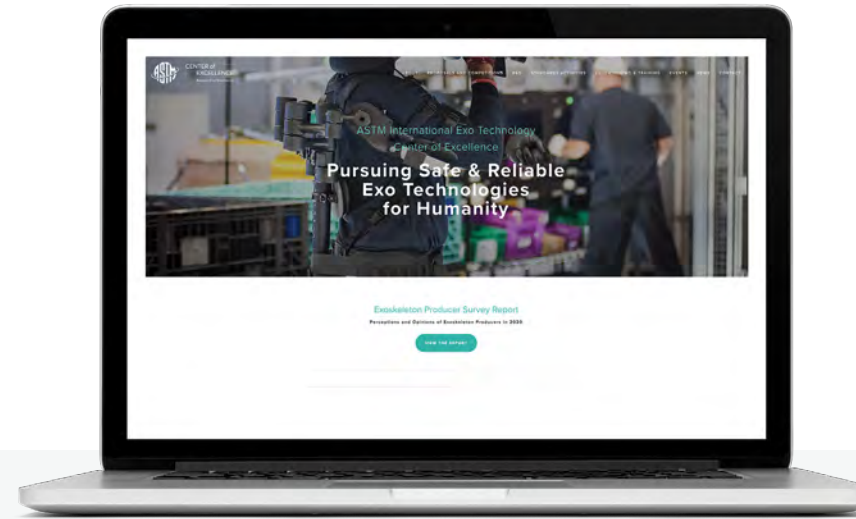
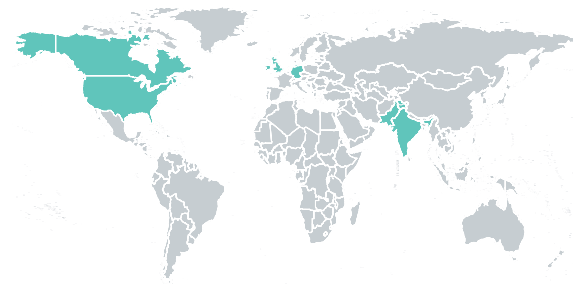
Podcasts: **35**

etcoe.org

Visits from 60+ countries

Top 5 countries:

USA | GERMANY | INDIA | CANADA | UK



RESEARCH-TO-STANDARDS AREAS

HUMAN FACTORS AND ERGONOMICS

AUGMENTATION

DIGITAL MODELS

RELIABILITY

USER SAFETY

COMFORT AND FIT

PHYSICAL/DIGITAL COMPONENT CHARACTERIZATION

R2S PROJECTS


\$500K

invested by ASTM and our research collaborators in accelerating exo technologies, supporting new standards, and generating new ideas

Doubling our reach by collaborating. Every dollar invested in research by ASTM is matched by in-kind contributions by our partners.


10

research collaborators from **6** Universities, **2** Private Companies, and **2** U.S. Federal Agencies


12

standards working groups supported


9

major presentations to global audiences to share information and educate on exo technologies

LEADERSHIP

ADVISORY BOARD

The CoE's Advisory Board was chartered to provide vision and direction of the CoE to ensure that it remains current with the existing and future drivers of the exo technology industry. The current Advisory Board members are:



David Audet
U.S. Army Combat Capabilities Development Command Soldier Center



Hany Demian
U.S. Food and Drug Administration



Hugh Herr, Ph.D.
Massachusetts Institute of Technology



John Howard, MD, MPH, JD, LLM, MBA
U.S. Department of Health and Human Services



Philip Mattson
U.S. Department of Homeland Security



Jim Miller
Sarcos Defense



Samuel Reimer, Ph.D.
Ottobock Industrials



Connor Walsh, Ph.D.
Harvard University



CORE TEAM

A world-class ASTM International team coordinates the day-to-day management of the ET CoE and coordinates across ASTM, other Standard Development Organizations, and Stakeholders.

William “Bill” Billotte, Ph.D.

ET CoE Executive Director

Nora Nimmerichter

Staff Manager and ET CoE Liaison

Jonathan Ghering

ET CoE Intern

Len Morrissey

Director, Global Business Development & Strategy

Tessa Sulkes-Llewelyn

Manager, Business Development

Athena Huss

Instructional Designer, Training and E-Learning

Andy Buckmaster

Director, Multimedia

Pat Picariello

Director, Developmental Operations

Brian Meincke

Vice President, Global Business Development and Innovation Strategy



Research to Standards

EXO TECHNOLOGY