Athletes gathering for the winter Paralympics in South Korea this month are remarkable examples of how people overcome challenges – and new technologies are increasingly helping these impressive athletes push their limits by doing more, going faster or going farther.

In this year's winter games, specialty equipment used by athletes includes prosthetic limbs and joints, chair-skis, sleds for ice hockey and high-tech wheelchairs for curling. In years past, summer sports have featured running blades, sleek racing wheelchairs and advanced bicycles to accommodate riders' unique abilities and needs.

Thanks to cutting-edge technology and improvements in materials and design – including innovations made possible by petrochemicals – advanced prosthetics, adaptive sporting equipment and wearable robotics are improving the quality of life for non-athletes too. These devices rely on lightweight materials to provide patients with durable, yet comfortable support to overcome a range of mobility challenges. Plastics producers supplied by petrochemical manufacturers across the United States play a crucial role in the development of many of these products, which frequently use lightweight engineering and fiber-reinforced polymers to produce long-lasting and versatile devices.

Athletes in the Spotlight

These products are empowering Paralympic athletes and increasing mobility in a multitude of areas and events. **Amy Purdy,** an American snowboarder, has relied on prosthetics since she was only 19 – when her legs were amputated below the knee due to bacterial meningitis. Not only was she a bronze medalist in the 2014 Winter Games, but she has also competed in *Dancing with the Stars* thanks to her advanced, customized carbon-reinforced prosthetics. This year, she'll use carbon fiber foot blades and composite-based prosthetic feet as she takes to the slopes – a combination that she has spent years testing and perfecting. These blades have to be strong enough to handle significant force, yet light enough to be comfortable and move freely. Epoxy resins and advanced materials like para-aramid fibers and ultrahigh molecular weight polyethylene made from petrochemicals like ethylene and xylene make these modern prosthetics a reality.

Beyond prosthetics, adaptive sporting equipment is also playing a key role in empowering these athletes. **Andrea Eskau**, a Para-biathlete and cross-country skier from Germany, competes with a ski sled made of carbon fiber-reinforced epoxy (made from ethylene), which is 30 percent lighter than traditional options. **Andy Soule**, meanwhile, uses specialized sit-skis for cross-country skiing. A former Army specialist who was injured in Afghanistan in 2005, Soule's sit-skis are similar in principle to a wheelchair, but with no moving parts. A customized interface helps secure riders to the skis – and allows them to navigate on the same kind of skis any athlete would use. Soule propels himself using the strength of his arms and core, and the lightweight carbon fiber seat lets him navigate the course with speed and agility.

Other people are benefitting too from adaptive sports equipment and mobility-enhancing devices. After breaking her back in 2007 and becoming paralyzed from the chest down, 32-year-old **Claire**

Lomas walked all 10 miles of the Great South Run in Portsmouth, UK – wearing a full-body, robotic exoskeleton suit. After a grueling 24 hours, Lomas crossed the finish line in her high-tech suit made from engineering polymers – greeted by her cheering fans and two young daughters.

Exoskeletons Restoring – and Enabling New – Motion

Lomas is just one of many individuals who have overcome major hurdles with the high-tech support systems like exoskeletons. For physicians across the country, lightweight exoskeletons made from engineering polymers are expanding options for patients with a range of mobility issues: from people with multiple sclerosis or cerebral palsy, to those recovering from spinal cord injuries or strokes. These devices not only provide support, but they can help patients adjust their stance and improve posture to retrain walking patterns or practice repetitive motions that are essential for neuro motor recovery. Exoskeletons can also help users strengthen muscles and improve coordination across the body – helping them reduce the risk of muscular dystrophy and empowering them to live more freely and accomplish more on their own. These devices are now practical because the polymers allow them to be much lighter in weight than something made from metal. And those polymers are made using petrochemicals like ethylene, propylene, benzene and xylene.

Exoskeletons, prosthetics and adaptive sports equipment are enhancing movement and enabling progress for people around the world, and their use is only expanding thanks to improvements in design and the low-cost and availability of materials such as plastics. From Paralympians to patients to assemblymen, these products are not simply enhancing mobility and strength – they are transforming lives.

Change is not limited to the health field. Manufacturing workers are also reaping the benefits of advanced, durable robotics – using exoskeletons to lessen physical demand and reduce injury from repetitive tasks. When lifting heavy objects or performing over-the-head tasks, assemblymen and other manufacturing workers are using devices that look like high-tech back braces with arms for assistance and additional support.

The introduction of these devices is being welcomed by workers everywhere – some of whom are lifting their arms on average 4,600 times each day. Users report that exoskeletons not only reduce soreness from a long day's work, but they are leaving work each day with more energy to enjoy their lives when they get home. While exoskeletons have yet to be universally adopted across the medical and manufacturing industries worldwide, they are on the path to becoming indispensable in a matter of years.

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