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Introduction

Think about items you have purchased recently for your home or personal use, like a laptop, furniture, appliances, food, make-up, sneakers, and clothing. All of these items are 'consumer goods' and engineers are a critical part of getting products like these from the drawing board to the marketplace and into the hands of the public. Consumer goods encompass such a wide variety of market segments and types of products that it's hard to do justice to the role and place of engineers across such an enormous and varied industry. Therefore, in this module, we will look at engineering for consumer goods through an examination of one of its most exciting segments – the sporting goods and equipment industry.

The sporting goods and equipment industry is an incredibly vibrant and fast-growing segment of the consumer goods industry and of the economy as a whole. Consumer appetite for the latest sports equipment, accessories and apparel is driven by rising participation levels in recreational sports, awareness and interest in physical fitness, and the popularity of the athletes associated with particular items or brands. Snowboarders, swimmers, tennis players, cyclists, and runners all want to perform better, compete longer, and of course do so with as few injuries as possible.

In order to meet these expectations, the sporting goods industry needs people with engineering backgrounds. Biomechanical, chemical, electrical, material, manufacturing, and mechanical engineers will all find positions to suit their skill set. And, one of the most appealing things about pursuing a career in this industry is that while you are making use of your engineering skills, you also get the opportunity to leverage and pursue your interests in sports.

Many of the people hitting the slopes each winter are engineers working on the latest products designed to enable skiers and snowboarders to move faster, turn tighter, and stay warmer and more comfortable longer. Of course, summer sports also offer engineers the chance to combine work and recreation. In fact,

Educational Goals:

After completion of this module, you should:

- Be familiar with the scope of and future directions for the sporting goods and equipment sector of the consumer goods industry.
- Have a greater understanding of the operations and standards that are used in the development and production of sporting goods.
- Be able to identify and evaluate the opportunities available to engineers in the sector.
- Be prepared to start a productive and focused job search.

some of the most exciting sports engineering innovations in recent years have come from the field of swimming and swimsuit design. Suits these days are as much equipment as they are apparel – made from materials that protect the wearer from damaging UV rays and with surface patterns that increase product longevity and actually *enhance* athletic performance by keeping friction and drag down.

Other areas where engineers are changing the face of sports include the development of a new generation of specially adapted equipment - such as skis and sports wheelchairs - for those with various disabilities to participate in the sport of their choice.

Overall, engineers engaged in this work are using their passion for sports to enhance the experience of others who share their interests.



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Industry Scope

Every year sports lovers hit the slopes, the pool, the court, and the field to participate in everything from cycling to snowboarding, to play tennis or baseball, to enter skating competitions, to run marathons, and to go rock climbing. The sporting goods industry has grown into a multi-billion dollar business providing the shoes, skis, balls, helmets, and vast array of other items that help participants go further, faster, higher, and perform better.

The sporting goods sector is made up of companies engaged in the design, development, and testing of sports equipment. These are the companies that make the bicycles, tennis rackets, cross trainers, and gym clothes we use when we go out to play. They may specialize in a single item or goods for a particular sport, or they may put out a wide range of products suitable for a number of activities. They might be a supplier who has developed a new cushioned insert for running shoes or a new substance to coat snowboards.

For all the variety and diversity among the members of this sector, the one thing that they all have in common is the drive to improve and innovate. Sporting goods makers are constantly striving to create and adopt new technologies, with great success. Equipment manufacturers make sure that new technologies are introduced as soon as they can be tested and put into production. All this is in effort to get consumers to buy new goods, upgrade their old ones, or add new accessories to their previous purchases.

All that effort pays off. This sector is more profitable each year. Recent surveys estimate that the world consumption of sporting goods in 2006 reached an all time high of \$256 billion. Manufacturers' sales in the U.S. were \$66 billion - an increase of 13% over 2005. Though that was a particularly sizable increase, sales have been increasing steadily over the past several years. According to the Sporting Goods Manufacturers Association (SGMA), much of that success comes from the overall growth in sports apparel and footwear. With positive and enthusiastic consumer responses to



technological advances in performance fabrics, this category has seen sales increase 20% over the past two years.

While the U.S. has the largest consumer market for athletic consumer goods, other markets – especially in China and the rest of Asia – are booming as well. China's impact on the consumer goods industry as a whole has been significant for many years, with companies sending manufacturing functions overseas in an attempt to gain a competitive edge on price.

In an industry this varied and immense, engineers play many different roles, and our next section touches on just that idea.



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Industry Operations

If you consider the wide range of items that make up sporting goods and equipment, you won't be surprised to find that there is no single, consistent process for the development and production of all of them. The process by which sporting goods go from "idea to market" is as varied as the products themselves. One thing that holds true for the development and production of all sporting goods – and consumer goods as a whole – is that engineers are involved in the entire process.

In the [Job Functions](#) section of this module, we'll give you an example of piece of equipment going through the various stages of the product development process and the engineers' role in that process.



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Industry Operations

Industry Standards

Companies and organizations in the sporting goods and equipment industry have industry standards to which they adhere and that provide guidance and direction to engineers in the field. These standards are written by experts with knowledge and expertise in the field and may run from just a few paragraphs to hundreds of pages. Standards are not unique to this industry, of course. They promote safety, reliability, productivity, and efficiency in almost every industry that relies on engineering components or equipment.

Some of the organizations providing standards to the engineers in this industry include:

- [ASTM International](#)
- [Consumer Product Safety Commission](#)
- [National Operating Committee for Standards for Athletic Equipment \(NOCSAE\)](#)
- [Outdoor Industry Foundation \(OIF\)](#)
- [Sporting Goods Manufacturers Association \(SGMA\)](#)



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Overview

Engineers are integral to the entire process of product development in the sporting goods industry. With such a broad range of products in this industry, its not surprising that each product presents different challenges and opportunities to engineers.

If we follow the path of a single item – snowboards, for instance - we can see in very broad strokes, the engineering development process for consumer goods from research to design to testing and production. In the sections to follow we'll do just that, highlighting the role of the engineer.

Following the description of the product development cycle, we'll also go through engineering functions that are discipline specific and that cut across a range of products.



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Job Functions

Research & Design

Research

One of the first things that happens in the life span of a new snowboard is research. Engineers are a central part of the multidisciplinary team that considers who the target consumer is and how the product will be used. Is it intended for experienced snowboarders or novices, children or adults? Is it being created for recreational use or professional competition? How will this board be different from boards already available? What shapes and materials can be used to result in faster speeds or the reduced vibration levels that can give riders more control? Once the answers to these questions have been answered, product specifications and some broad initial designs are created and passed on to the engineers in the design and development phase. Specifications may cover details such as edge design, dimensions, strength vs. flexibility, as well as look and feel.



Design and Development

Once the team knows who they are designing a new board for, the decisions can be made about what shapes and materials to use. If the board is being aimed at female users, the engineers will explore shapes that are shorter and narrower, which give more control to a user with a smaller foot. The curve of the hourglass shape – known as a sidecut – will be more pronounced, making turning smaller boards easier. The materials used will need to meet flexibility levels, which for a women's board will be higher than for a men's since a board's 'flex' is tied closely to the rider's weight. Once designs are laid out in detail, physical and virtual models or prototypes are created so that the engineers can see how the designs and materials will look and behave under different conditions.



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Job Functions

Testing & Production

Testing and Prototyping

Testing and prototyping verifies the work done in the design phase. Models are built using clay, foam, or almost any material in order to communicate quickly the idea of the board's specific shape. Virtual prototyping, which involves using computer-assisted design (CAD) programs to create 3D models, can be used to establish such things as the correct proportions and overall dimensions suitable for the widest cross-section of users, or how materials might layer most effectively to create a core of the specified strength and flexibility. Physical, fabricated prototypes are fully functional boards that can be taken out to slopes under different snow conditions and with test subjects of various height, weight, and experience levels to make sure the design performs to expectations.



Production

Production and manufacturing engineers create detailed drawings and component specifications informed by the results of the testing and prototype phase. They design assembly techniques and facilities that ensure the boards are made efficiently, cost-effectively, and consistently throughout the product run. Other engineers are involved in tasks like sourcing third-party vendors for materials and designing packaging.



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Job Functions

Areas of Expertise

What other types of work are engineers involved in across the sporting goods and equipment spectrum?

Materials and Textile Engineering

These engineers study and test materials - or combinations of materials. Engineers working on athletic shoes have to consider materials for each piece of the shoe. Materials must not only provide shock absorption and flexibility, but must be suitable and effective for wearers with different gaits and types of movement, of various heights and weights, and on different surfaces. They develop sole patterns that enhance traction and cushioning systems intended to distribute impact. One of the latest shoes from Adidas – the Adidas-1 - incorporates technological advances in cushioning that enable shoes to adapt to the individual runner, depending on running style, surface, pace, and body structure.



Engineers also study how fabrics and dyes used in recreational swimsuits stand up to water and weather conditions. They test different fibers and fabric processing methods to see how they stand up over time and how they hold their shape. Other textile engineers are working on the next generation of UV-protective garments for participants in sports of all kinds. They are designing new weaves and fabric blends, as well as testing which chemical finishes will afford the wearer the most protection while still allowing the fabrics to breathe.

Biomedical and Biomechanical Engineering

Biomedical and biomechanical engineers will find themselves in demand across the sporting goods sector. These engineers analyze the body's motion during athletic movement to better understand the equipment and training needs of the athlete, finding ways to increase performance and prevent injury. They also study how environmental factors like temperature, wind, rain, and terrain act on the body. They measure and assess how our limbs move and how different surfaces

act on our muscles. For example, an analytical device called a force platform is used to assess the way athletes move and how the shoe can enhance that movement. This device measures variations in forces under the foot during running. Pressure points across the surface of the foot can be examined at different speeds and on a variety of surfaces.

Mechanical and Electrical Engineering

Mechanical and electrical engineers design instrumentation and testing processes that measure, calculate, and assess a product's attributes and specifications. For example, using finite element analysis, mechanical engineers can predict the levels and location of stress and make recommendations for changes in material or assembly of a product. This is applied, for example, in bicycles, where stress can cause the performance and the lifespan of individual bike components to degrade.

As another example, in many sports where vibration can negatively impact performance, piezoelectric sensors have been developed and included in equipment like tennis rackets, skis and snowboards. These sensors convert vibration waves into heat or electricity. That heat helps keep more ski or board on the snow surface, creating more stability, and minimizes the sting of impact in rackets, giving the player more accuracy and control over the trajectory of the ball.

Aerodynamics

Engineers specializing in aerodynamics play a role in the development of various sports balls – soccer balls, tennis balls, even badminton birdies – all of which must be examined in light of issues like differences in drag, distance, and loft.

Aerodynamics is also important for cyclists and the companies that make the equipment they use. Using computational fluid dynamics (CFD) software, aerodynamics engineers examine the airflow around the bike and rider. Using CFD saves time and money by using 'virtual' testing, allowing minor changes to components such as handlebars and front forks to be made without actually having to build physical prototypes.



Companies

This list represents many of the key players in the industry but it is by no means meant to be a comprehensive list of employers in the field.

- | | |
|------------------------------------|----------------------------------|
| Adidas | Miken |
| Akadema | Mizuno |
| All Star | Nike |
| Anderson | Nokona |
| Atec | Ping |
| Bauer | Prince |
| Brunswick | Puma |
| Callaway | Rawlings |
| CCM | Reebok |
| Coleman | Roy Hobbs |
| Converse | Russell Athletic |
| Easton Sports | Schutt |
| Everlast | Spalding Sports |
| Franklin Sports | SSK |
| Glovesmith | Taylor Made |
| Head | Under Armour |
| Jugs | Wilson Sports |
| Louisville Slugger | Worth Sports |
| MacGregor | |



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Industry Outlook

Overview

According to the Bureau of Labor Statistics, the job outlook for engineering in general is expected to be good, offering growth slightly faster than the national average for other types of employment. Of course, this varies from specialty to specialty, but the consumer goods industry is a strong one, and within it, sporting goods and equipment shows every sign of continued expansion and growth. What economic and market forces make engineers such a valuable commodity for the companies in consumer goods?

Competitive pressures and advancing technology will force companies to improve and update product designs and to optimize their manufacturing processes. Employers will rely on engineers to further increase productivity as investment in plant and equipment increases to expand output of goods and services. New technologies continue to improve the design process, enabling engineers to produce and analyze various product designs much more rapidly than in the past. Unlike in other fields, however, technological advances are not expected to limit employment opportunities substantially, because they will permit the development of new products and processes.

Bureau of Labor Statistics, U.S. Department of Labor, [Occupational Outlook Handbook](#), 2006-07 Edition, Engineers

This competitive drive and technological development - when applied to the sporting goods and equipment sector - is good news for engineers looking for opportunities to put their passion for sports to work over the next few years. Of course, success for the companies and organizations involved in the design and manufacturing of sporting goods is tied to the spending levels of those participating in



sports recreationally. The news on those fronts is also good for engineers considering a career in this field.

Sports will remain a popular, central activity around the world, and participants - especially passionate enthusiasts - will always want the latest, cutting-edge accessories, gadgets, and products to help them excel at their chosen activity. But what other factors might influence the outlook for sporting goods and equipment?



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Industry Outlook

Industry Trends

Spending Levels and Baby Boomers

The greatest factor influencing the growth in this sector is the steady growth of disposable income. Every year for the last five years, disposable personal income increased five percent. When people have more money, they spend more on themselves and their interests. During the same period, personal consumer spending for sporting goods increased six percent. This growth is expected to continue at least over the next 5-10 years, and probably longer.

As impressive as this steady growth is, the 70s, 80s, and even 90s showed tremendous jumps in spending levels for sporting goods. What was driving force behind the robust spending of those decades? Baby boomers - that large demographic of people born between 1945 and 1965. Any discussion of consumer spending and habits will touch upon this economic force, and the economics and productivity of sporting goods is no exception.

Through the 90s and up to the present day, the baby boomers as a group have turned their attention to lower-impact activities. So, while they are still spending, the types of apparel and accessories they are buying has changed.

Expanding Global Consumer Marketplace

China and India are both fast becoming full-fledged consumer societies. Disposable income in both of these developing economies is rising quickly and many of the sporting industry giants are making a significant investment in time and resources to capture the attention of these new consumers. Demand will rise for the current product lines, but new products will be needed as well. To meet the demands of these markets, companies will need to expand the scope and reach of their resources and facilities. Engineers will be a vital part of this expansion.



The increase of imports is another industry trend. As a general rule, goods manufactured in countries like China, Pakistan, and Indonesia (all major sporting-goods-producing countries) cost less, since labor costs in those countries are significantly lower than labor in the United States. Since labor is a significant cost in the production process for sports equipment, many manufacturers are choosing to import products so prices are more attractive to retailers and consumers. Like so many trends at play in sporting goods, this is true across the consumer goods industry.

Outsourcing manufacturing does not necessarily mean bad news for domestic engineering jobs in the sporting goods sector. While manufacturing jobs in the U.S. may decrease, the engineering and design portion of the production process, as well as management and marketing functions, are still handled domestically and will be for the foreseeable future. Price is not the only advantage in marketing sporting goods and equipment. Innovation and performance are major selling points and major sports manufacturers are going to need engineering teams to keep producing that valuable competitive edge.

Environmental Consciousness

The environment has been an increasingly important social issue and these days it has also become an important business issue across many industries, not the least of which is the sporting goods and equipment sector. The "Green Revolution" in the sporting goods industry is being led by companies that have started recycling programs, implemented greener manufacturing processes and drawn up environmental impact plans for everything from plant development to waste management and the transportation of goods and materials.

Nike, for example, is a leading proponent of greater sustainability. For the past 15 years, Nike's 'Re-Use A Shoe' program has been a shining example of how big an impact a little innovative engineering can make by significantly decreasing the waste levels in landfills and making things a little brighter for communities around the world. The program takes the millions of pairs of athletic shoes (of any brand – not just Nike) discarded every year and recycles the materials for use in basketball and tennis courts, track and field facilities, and the playgrounds that are part of Nike's community investment programs.

Sustainability will continue to be a critical social and business issue for the foreseeable future. Any company that wants to address the issue seriously and succeed as a good social citizen will be calling upon engineers to find ways to accomplish that goal.



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Mapping Your Career

Educational Preparation

College/University Coursework

The majority of engineering programs—regardless of specialty - include core curriculums that will enable the recent graduate to work in any of the job functions discussed in previous sections. If, however, you want to start pursuing this specific path right away, the coursework you'll want to consider if you have an interest in this field would be:

- Aerodynamics
- Biomechanics
- Dynamic Systems & Control
- Fluid Mechanics
- Functional Anatomy
- Medical Imaging
- Physiology
- Robotics
- Sports Engineering
- Sports Injuries and Repair
- Sports Materials
- Stress Analysis & Design
- Structural Analysis
- Thermodynamics
- Thermo-Fluids
- Tissue Engineering

Internships

Workplace experience is one of the best ways to prepare for any engineering career. You'll learn not only about the companies themselves, but also about how the industry works and what roles engineers play in it. You'll see how different segments of development and production work together, and what kinds of non-engineering skills you will need to be a productive member of the industry workforce.



Many of the major players in the industry have programs to bring students at all levels into the workplace and give them real-world experience. Some organizations and companies with internship programs are:

- [Adidas](#)
- [Nike](#)
- [TeamWorkOnline Internship Listings](#)

It's not only sports manufacturing and supply companies that offer internships. Don't forget to check with a sports' national governing body (NGB) or federation. The [United States Olympic Committee Internship Program](#) is only one such possibility. The program at [USA Track & Field](#) is another. Most governing bodies have a sport science manager(s) that coordinates science, engineering, and/or technology projects. The United Ski and Snowboard Association (USSA) for example, is the NGB for Olympic skiing and snowboarding in the USA, and as part of their USSA Sports Science Program they offer internships in Biomechanics, Strength & Technology. [Get more information on internships.](#)

Another good source for "out of the classroom" experience are research centers like the [MIT Center for Sports Innovation](#), where students get the chance to work on sports technology studies, do product development work, and examine how the engineering disciplines they are learning about get applied in real world situations.



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Mapping Your Career

Finding the Right Job

A job search actually starts long before you end the first resume. It starts with a decision on what areas of the industry to focus on. Then you focus on companies and opportunities in those areas. How do you make that decision? With research.

Research

Get to know the industry - the trends and current events - and get to know more about the key players and firms in the field as well.

- **Newspapers:** The consumer goods industry is covered in one way or another by nearly every newspaper department, and it occupies a prime position in the business section of the major news outlets. Begin by scanning your local newspaper's business section as well as the *Wall Street Journal*, *New York Times*, and the websites of other major dailies. Information on the companies and organizations in the sporting goods sector will be part of the business coverage, but to get more detailed information on the sector as a whole, check out the sports and lifestyle sections as well. Equipment trends and innovations, and performance enhancing technologies and materials are big news in these sections, and watching for news like this can give you a good idea of which companies are working in your fields of particular interest.
- **Trade and Industry Publications:** The next set of publications you should review regularly are trade and industry magazines, such as *Sporting Goods Business*, *Entertainment Engineering*, and even *Sports Illustrated*. And don't forget the publications on specific sports like *Snowboarder Magazine*, *Runner's World*, and *Tennis Week*. Whatever is happening in a sport itself will have a great impact on the companies that are making the equipment and accessories used by the participants. Publications like these report on all aspects of the



industry, make product recommendations to consumers, and can help you focus your search and target specific companies.

Once you have your industry sources established, you can start researching the companies you intend to target. Don't forget that one of the best sources of information about a company is the company itself. Most company websites include not only information on product lines, but also company history and links for employment opportunities. For a list of leading companies in the industry, check out the [Companies](#) section in this module.

On-campus Resources

Many companies visit campus for recruiting purposes. Your university Career Services Office should be able to tell you what companies are coming and when. They might also be able to provide information and contacts related to internships. For more information on using these on-campus options, our [Career Planning](#) module.

Networking

Many people dismiss networking as simply "asking around" but it's much more than that - it can be the key to getting in the door and standing out from the crowd. You might hear of job openings not yet advertised or about people who plan to leave a job in the near future. Another advantage is that being able to associate yourself with someone known to the hiring manager means you will have an edge in your first interview over an applicant who is just one of many names on a list. For tips and suggestions on effective networking, review our [Career Planning](#) module.

Online Job Listing Sites

You can certainly find industry jobs on the large, general job-listing sites like Monster.com or careerbuilder.com, but winnowing down the list to the jobs in areas you want to focus on can be time consuming. Still, these resources are very comprehensive and it's worth looking at them—if only to get a sense of the range of engineering positions available at any given time.

If you want to give your search more focus, you should check out these sites specifically aimed at those looking for positions in the sporting goods and equipment field:

- [ISEA Job Listing](#)
- [NMNA JobMart](#)
- [NSGA JobCenter](#)
- [SGMA Job Board](#)
- [Women's Sports Jobs](#)

- [TeamWork Online](#)

Additional resources can be found in the [Industry Resources](#) section in this module.



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Mapping Your Career

Staying Current

Continuing Education

Success is more than showing up regularly and doing your job consistently. You must continually strive to improve your performance and expand your knowledge. So, how can you keep your edge and stay ahead of the curve? Staying apprised of the latest industry news, as mentioned previously, is important, but another important channel for improvement and success is through continuing education options like online classes, seminars, and conferences. Professional societies like the ASME are great places to start to find resources like these.

- [ASME Continuing Education Institute](#)
- [ASME Professional Practice Curriculum](#)
- [NSPE's virtual classroom](#)

More professional development options can be found through publications and sites listed in our [Industry Resources](#) section.

Networking as an Ongoing Practice

Networking as a career development tool does not stop once you get your first job. It will be a valuable way to help move up the career ladder. If you have the opportunity to participate in your company's rotation program or to attend industry meetings and conferences, take advantage of it.



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Industry Resources

Reading: Magazines, Journals and Websites

- [Athletic Business magazine](#)
- [Boating Industry magazine](#)
- [Entertainment Engineering magazine](#)
- [ESPN](#)
- [Sport and Technology](#)
- [Sporting Goods Business](#)
- [Sports Business Research Network](#)
- [Sports Engineering Journal](#)
- [SPORTSCIENCE](#)
- [SportsOneSource](#)
- [Web Street Golf Report](#)
- [BioMechanics magazine](#)
- [The Sport Journal](#)
- [Sports Biomechanics](#)



Professional Societies and Associations

Professional organizations offer opportunities to meet, network, and exchange technical information with other industry professionals. These activities keep engineers connected to the latest technological advances and also aid in their professional advancement.

Professional societies also offer information on careers, industry information, and events that can be invaluable, not only as you start your job search, but later on as you seek to take your career to new levels. Some you might want to check out include:

- [American Apparel & Footwear Association \(AAFA\)](#)
- [American Sport Fishing Association](#)
- [International Sports Engineering Association \(ISEA\)](#)
- [National Association of Sporting Goods Wholesalers](#)
- [National Golf Foundation](#)
- [National Marine Manufacturers Association](#)
- [National Sporting Goods Association](#)

- National Sports Shooting Foundation
- Snowsports Industries America (SIA)
- Sporting Goods Manufacturers Association
- World Federation of the Sporting Goods Industry
- International Society of Biomechanics in Sports



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Summary

We've used the sporting goods and equipment sector to illustrate the possibilities open to engineers in the consumer goods industry. In the same way, we've chosen representative sports and activities to demonstrate the types of challenges and opportunities available to engineers in developing products across the whole spectrum of athletic pursuits. There are countless other sports that require equipment to be designed, produced, and improved to keep up with consumer demand and help participants get the most out of their game of choice.

Engineers bring the knowledge of materials, aerodynamics, chemistry, and mechanical and electrical systems together to enhance athletic performance, prevent sports-related injuries, and ultimately increase the enjoyment for participants at all levels of sport. They study the way athletes move when engaged in various activities - and the result is a bike, a swimsuit, or a shoe that works with the athlete, and training equipment that targets specific strokes, gaits, and stress points. They study the effects of wind, water, snow, and other elements on the balls that fly over courses and across nets. They develop different layering schemes that will make one set of skis appropriate for a novice who is just finding their feet on the slopes and another set perfect for the accomplished, long-time skier.

The sector is a vibrant and growing part of the consumer goods industry, and engineers looking for a chance to combine a personal passion with work on creative, cutting-edge projects will find few areas more likely to offer that enviable opportunity.

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