Journal of Ergonomics
ISSN: 2165-7556
OPEN ACCESS Freely available online
Editorial

# The Rise of the Exoskeletons

**Jeff Hiserman PT***

*Physical Therapy Assistant Program, Industrial Design Departments, Pennsylvania College of Technology, USA*

## EDITORIAL

The name itself conjures up images of an onerous insect or a lumbering robot. In 2014, these lumbering robots came to life in the United States--well, almost. The U.S. Food and Drug Administration (FDA) approved for the first time an exoskeleton device, a wearable, motorized device designed to help people ambulate. The device is giving new hope to people suffering from lower-limb paralysis [1]. There is an increased demand for exoskeletons due to their decreasing cost, improved efficacy, and more user friendly than ever before. The global exoskeleton market will expand in the forthcoming years due to these factors.

Exoskeletons, in their more primitive form, have been around since the mid 1500's. Ambroise Paré , a French surgeon, is considered the father and creator of the orthopedic devices, developing a number of instruments and artificial limbs [2]. More recently, in 1967, a professor of physiology, Dr. Robert F. McDavid, invented the first lateral knee brace designed to prevent injury or reinjury. His brace provided lateral protection of the knee and was used by Hall of Fame New York Jets' Quarterback Joe Namath who played with the now-famous Lennox Hill knee brace from the 1967 season and throughout his career. This brace kept him playing despite being plagued by knee problems. This knee brace was so iconic that it earned itself a place in the Pro Football Hall of Fame [3].

Fast forward to 2020, and these systems have morphed into wearable devices used by workers in industrial workplaces. They are used to enhance manual tasks and to amplify the human operations. They are also known as robotic suits or powered armor, due to their high level of accuracy in improving manual labor. With mechanical loading as the main risk factor for LBP, exoskeletons are designed to reduce the load on the back by taking over part of the moment normally generated by back muscles [4].

The growing demand from the health care industry, as well as, the manufacturing industry, has been the primary driver for this market. The need for load bearing and shifting in manufacturing, in order to prevent injuries, is a prime reason for the growth in both development and sales. The total cost of work injuries in 2017 in the US was $161.5 billion which includes wage and productivity losses, medical expenses, and administrative expenses [5].

For all the meticulous university laboratory designs and long-term industry testing that has been done recently, the biggest factor for use is this; laborers with positive attitudes toward exoskeletons are more willing to use them of for their work [6]. This study showed that the perceived ease-of-use and perceived practicality of exoskeletons play an important role in predicting a laborer's intention to use them.

Currently, with their increased use in the industrial and military sectors, along with the advent of soft actuators, results in the increasing demand for both active and passive exoskeletons. Consequently, the sales of exoskeletons have increased over 40% from 2017 to 2018. The two largest markets presently are North America and Europe, since these regions have a high rate of technological advancements compared with other regions in the world. Also these regions have had early use of these systems, compared to other regions. The Asia Pacific region is anticipated to dominate the market beyond 2020 because of the presence of a high number of major players and continuing industrial, defense, and medical advancements in this region [7]. Some of these players are, Ekso Bionics, Parker Hannifin Corp., Comau, Lockheed Martin, Lowe's Innovation Lab, and Daewoo Shipbuilding & Marine Engineering [8].

Yet despite the optimism and growing sales forecasts, the goal is to make them lighter and easier for the user to suit up in; as this is what people feel good about with these systems. Additionally, they don't want restrictions to their motion. It is this balance between ease of use and minimal restrictions with motion, which is making the engineering difficult for now. It is believed that within the next decade, the technology will have advanced sufficiently to enable them to be very accessible in many different settings [9].

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**Correspondence to:** Jeff Hiserman PT, Industrial Design Departments, Pennsylvania College of Technology, USA, Tel: 570-495-3298; E-mail: jph21@pct.edu

**Received:** February 22, 2020; **Accepted**: February 24, 2020; **Published**: February 29, 2020

Citation: Hiserman PTJ (2020) The Rise of the Exoskeletons. J Ergonomics 10:e186. DOI: 10.35248/2165-7556.20.10.e187.

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