



THE BUSINESS MRI REPORT

**Musculoskeletal
Injuries in the
Construction Industry**





INTRODUCTION

Musculoskeletal injuries caused by overhead construction work are having a profound effect on the construction industry's businesses and employees.

Businesses are losing productivity due to musculoskeletal injuries and an employee's wellbeing is at a risk if they suffer any kind of injury.

These businesses must also cater for the construction industry's diverse and ageing workforce, which needs support against the risks of musculoskeletal injuries.

Musculoskeletal Injuries in Construction

Manual handling remains prevalent within the construction industry in the Republic of Ireland and continues to be a casual factor in a considerable number of injuries sustained by employees. 16% of all injuries in this industry were found to affect the back and of these 45% were reportedly due to lifting and carrying activities (HSA,2000-2002). More recent statistics show that in the construction sector manual handling accounts for approximately 27% of reported non-fatal injuries, and the most commonly affected body part is the back (17.4%). All the tasks observed were considered to expose individuals to a medium to very high level of musculoskeletal injury and ill health.⁽¹⁾

Altogether, HSE reports that 8.9 million working days were lost due to work-related musculoskeletal injuries in 2019/20.²

Overhead Work: A Major Risk Factor

Musculoskeletal injuries develop when biomechanical demands, such as extreme postures, repeatedly exceed the worker's physical capacity during construction work.

In this regard, overhead work has been identified as a major risk factor for this type of injury in the shoulder region.

Working with the arms raised over 90° for more than 10% of a worker's working hours increases the risk of work-related musculoskeletal injuries in the shoulder region by one to two thirds.³

Support is Needed

Overhead work remains a very common part of construction work today. And despite growing automation, numerous strenuous tasks cannot be fully automated, at all or at a reasonable cost.

One solution to physically relieve workers while keeping them in control of the task is to assist them with an exoskeleton. An exoskeleton is a wearable system that provides physical assistance to its user through assistive torques and/or structural support. As the system is worn on the body and follows the user's movements, no – or very limited – modifications of the workplace are required. Exoskeletons are drawing great interest from the industry to help alleviate some of the issues caused by overhead construction work.



EXOSKELETON:

Reducing Shoulder Strain

Improve Employee Wellbeing

Exoskeletons have proved that they can reduce pain and fatigue during overhead construction work by reducing the load on a worker's muscles and joints, while reducing stress on the body.

Exoskeleton Experiment Proves Capabilities

Group Subject Testing

As part of an experiment, a group of 12 persons with no known orthopaedic or neurological diseases (24 ± 3 years, 176 ± 15 cm, 73 ± 15 kg, six male, six female) were recruited as subjects. The subjects had no previous experience in using exoskeletons.

The aim of this principle study was to investigate the biomechanical effect of the exoskeleton in a laboratory setting that is similar to actual working conditions using objective measuring methods. In occupational medicine, electromyography is the standard method for testing strain and fatigue in individual muscles.⁸ Under defined conditions, the measurement of oxygen consumption can be an indicator for metabolic energy consumption.⁹ Together with the heart rate, oxygen consumption is a measure of the overall stress to the organism from non-maximum work, characterised from the physiological perspective by reaching a steady-state level.¹⁰

Experimental Set-up

After the study design was explained, all subjects were instructed in the correct execution of the task to be performed, including approximately 20 minutes of training with all the measuring equipment applied.

The subjects were then divided into two groups. The first group performed the task twice with the exoskeleton and once without the exoskeleton (A-B-A). The second group twice without and once with the exoskeleton (B-A-B). This was to minimise the impact of adaptation effects on the results. The measurement period for each task was five minutes to ensure that a physiological steady state was reached.

HEALTH AND SAFETY

Health and safety is a key priority for today's businesses and employees. Although the majority of people working in the construction industry care about health and safety and are diligent in their work, the construction industry remains one of the most dangerous sectors to work in when it comes to musculoskeletal injuries.⁴

34.1% of the top five accident triggers of non-fatal accidents in the Irish Construction Industry were manual handling.¹

Employee Wellbeing

Construction workers that are carrying out overhead work are at an increased risk of musculoskeletal injury. If this kind of injury occurs, a worker's mental state can also be affected.

Overhead work substantially increases injury potential as a result of increased physical load and reduced tolerance due to decreased blood circulation.⁶

According to an Arthritis and Musculoskeletal Alliance (ARMA) roundtable report,⁷ employees now want to know how they can protect their musculoskeletal health as well as reduce the impact of work on their musculoskeletal health and get better support from the company they work for.

There was a 20-minute break between each individual task. Before every task, the resting values of the metabolic parameters were measured in a two-minute sitting position. After the tasks, the values were recorded for another two minutes, also while sitting. Electromyographic signals were measured from segments of the deltoid muscle, which covers the shoulder joint, (acromial, clavicular and spinal part) and the trapezius muscle, which extends over the back of the neck and shoulders (ascending, transverse and descending part) as well as from the biceps brachii muscle that lies on the front of the upper head of the arm. This allows a detailed picture to be made of the activity of the shoulder muscles during a task.

Results

The resting values measured before and after loading show no significant differences for either oxygen consumption or heart rate, with and without an exoskeleton. During the task, significant reductions of the heart rate by 7% and of oxygen consumption by 11% were measured when the exoskeleton was used.

The non-significant differences in the resting values for the metabolic parameters prove that the breaks specified in the trial design resulted in complete recovery of the subjects, thus allowing reliable comparisons. Results show that using an exoskeleton significantly reduces the user's metabolic energy consumption. The electromyographic analysis demonstrates that strain in the shoulder region is considerably reduced with the exoskeleton. These results correlate with findings of other studies that demonstrate similar effects for individual muscles in the shoulder region.¹¹

In addition, the lower values for heart rate and oxygen consumption measured when using an exoskeleton correspond to a reduction in the overall stress to the organism, which was also determined in a previously-conducted experiment.¹²

In this study, the complex measurement of several muscle groups makes it clear that the reduction of muscle strain is most pronounced in the segments of the deltoid muscle in the shoulder and in the biceps brachii muscles in the upper arms.

Compliance

By its very nature, construction is a dangerous industry and is therefore subject to stringent and increasing health and safety regulations.

Regulations: Employers' Duties

Employers must protect the health and safety of their workers under the Health and Safety at Work Act.

The Management of Health and Safety at Work Regulations require employers to assess the risks to the health and safety of their workers. The regulations may identify risks covered by other regulations relevant to musculoskeletal injuries in the workplace and employers should also comply with those regulations.

Regulations: Employees' Duties

Under the Health and Safety at Work Act, workers must take reasonable care of their own health and safety and that of others affected by their work. Workers must also co-operate with their employer so they can comply with their health and safety duties. In addition, the Management of Health and Safety at Work Regulations require workers to make use of equipment their employer has provided for them, in accordance with their training and the instructions their employer has given them.

The Manual Handling Operations Regulations supplement these general duties in the case of manual handling. They require workers to follow systems of work established by their employer to reduce the risk of injury from handling loads.

Exoskeletons and Compliance

Enhanced Health and Safety for Employees

With a proven, multifaceted value proposition that meets the needs of construction companies, exoskeletons support construction workforces beyond regulatory requirements by offering enhanced levels of health and safety.

Health and Safety Credentials

Construction companies can utilise exoskeletons to attract and retain skilled workers, while showing regulators that the company is going the extra mile to keep employees safe and happy throughout their entire career.

It is important to note that there are currently no regulations around the use of exoskeletons.



PRODUCTIVITY

Productivity is key in the construction industry, and construction companies are always on the lookout for more productive solutions to increase profitability.

However, work-related musculoskeletal injuries are among the most common causes for inability to work in Germany and Europe,¹³ and therefore a significant cost factor for various companies.

Research by Loughborough University in the UK found that musculoskeletal injuries cost construction employers £646 million a year.¹⁴

In Great Britain alone, 18.4 days was the average time lost due to musculoskeletal injuries in 2019/2020.¹⁵

‘Presenteeism’

Referencing the research from Loughborough University, ARMA highlighted that many workers fear they will lose their job if they admit to suffering from any conditions. This leads to ‘presenteeism’ – where people come into work while sick, which can drive down productivity and increase costs. Their research also stated that early support is necessary to get people back to work and keep them at work. Support such as the creation of an open culture where physical problems are talked about onsite, as well as routine monitoring of employee musculoskeletal health and wellbeing.

Demand for Construction Work

Despite signs the overall economy may be slowing, most construction firms expect demand for their services and hiring will expand, but worries are growing about labour shortages and the quality of construction work.¹⁶ With a higher demand for construction work, it is inevitable that more musculoskeletal injuries will occur without further support for construction workers. However, construction companies are open to adopting productivity-boosting technologies to cope with worker shortages according to a recent report from the Associated General Contractors of America and construction software company, Sage.¹⁷

Exoskeleton: Addressing Productivity and Increased Demand

Exoskeletons are designed to enhance productivity by reducing stress on the body, causing less pain and fatigue due to a reduced load on muscles and joints. This reduced stress and increased comfort when working enables workers to improve their health and reduce the amount of sick days they take, provided that they still take the required rest breaks for physical and mental wellbeing.

Tests have proved the effectiveness of the exoskeleton in terms of reducing stress on a worker’s muscles and joints, to improve the health of a worker and minimise days lost through ill health.

By being able to retain skilled workers for longer periods of time due to less employee sick days, construction companies can utilise exoskeletons to improve operations twofold by improving employee wellbeing and increasing on-site productivity.

DIVERSITY IN THE CONSTRUCTION INDUSTRY

An Ageing Workforce

The construction industry has what is considered to be an ageing workforce as the number of workers above the age of 60 is increasing more than any other age group.¹⁸

The ageing workforce will have a serious effect on the industry, as essential skills will be lost when employees retire or are absent from work.

Absenteeism is an issue that is exacerbated by the fact that older workers are more susceptible to work-related musculoskeletal injuries than younger workers due to a decreased functional capacity.¹⁹ This refers to a person's ability to perform aerobic work as defined by the maximal oxygen uptake (VO₂max), that is, the product of cardiac output and arteriovenous oxygen (a-VO₂) difference at physical exhaustion.

Fewer Younger Workers

Coupled with the issues of an ageing workforce is the fact that the number of new recruits in the construction industry is declining, and there will be few workers available to replace those who are retiring.

A survey by YouGov found that just 3% of 18-24-year-olds (1% female) have actively searched for a role in the construction industry.²⁰

Attracting Skilled and Reliable Staff

Recruiting and managing staff in the coming years will be challenging for the construction industry. A scarcity of skilled labour driven by demographic shifts

including fewer younger workers, and the increasing implementation of technology (which demands broader skill sets from workers), coupled with the industry's high volatility of physical workforce demands, will be major tests.

It is also difficult for construction companies to retain skilled workers and retrain them throughout their working lives.

Female Workers

Although the construction industry is male-dominated, it's increasingly common to find women working in all areas of the construction industry. In fact 5,400 women have joined the industry since the Q4 2017 seeing the number of females working in construction grow to 12,500. According to Central Statistics Office (CSO) statistics, women now make up 8.49% (Q4 2019) of the total workforce in the Construction Industry, rising from just 5.3% in Q4 of 2017.

However, like the industry's ageing workforce, female workers need to be equally supported in all areas around how they do their job, including physically to prevent musculoskeletal injuries.

Exoskeleton: Improve Diversity

Exoskeletons help construction companies address many of the industry's diversity challenges. This is because exoskeletons help to attract and retain the best workers as candidates and current employees are likely to appreciate an employer's commitment to adequate health and safety commitments.

Featuring adjustable levels of support strength for use with various overhead applications, exoskeletons enable all workers – including the older generation, female workers and disabled workers – to utilise the technology's enhanced support features to complete activities more comfortably, while crucially reducing the risk of musculoskeletal injuries.



SUMMARY

Overhead work is a frequent cause of shoulder work-related musculoskeletal injuries. These injuries are among the most common causes for the inability to work in Europe, and are a significant cost factor for construction companies.

Today's construction companies must be aware of the issues caused by musculoskeletal injuries – from health and safety issues that affect employee wellbeing – through to productivity issues that increase absenteeism and diversity issues that companies must be aware of and cater for.

Exoskeletons offering arm support are able to reduce shoulder strain, without requiring a large-scale reorganisation of the workplace, enabling construction companies to cost-effectively implement exoskeletons in their business.

Crucially, exoskeletons are proven to reduce work-related strains on the musculoskeletal system, as demonstrated in a group experiment involving 12 people with no known orthopaedic or neurological diseases, or any previous experience of using exoskeletons. Results from this experiment clearly showed the drastic reduction of the user's muscular strain when using the exoskeleton.

The time to act against musculoskeletal injuries and support construction workers is now.

HILTI EXO SKELETON:

Exo-01

The Hilti exoskeleton is our newest addition to our portfolio that features unique health and safety benefits, enabling construction workers to reduce strain on the upper body during overhead applications, while improving productivity by reducing absenteeism.

Our universally-usable solution is suitable for an array of different overhead applications, and its adjustable strength settings enables construction companies to support diverse workforces, which in turn helps companies attract and retain the best workers in the construction injury.

**Discover more about the Hilti Exo Skeleton:
Exo-01**

DISCOVER MORE ABOUT THE EXO-01

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