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1. Introduction

Ergonomics, the science of fitting the workplace to the worker, is increasingly ***intertwined*** with high technology, leading to innovative solutions for ***safety***, comfort, and productivity. Emerging technologies like exoskeletons, wearable ***sensors***, and AI-powered tools are revolutionizing how ergonomics is applied in various settings, from manufacturing to healthcare.

High-Tech Ergonomic Solutions:

- **Exoskeletons and Exosuits:**
  These wearable devices can support workers during physically demanding tasks, reducing strain and fatigue.
- **Wearable Sensor Technology:**
  Sensors can track posture, movements, and muscle activity, providing real-time feedback and identifying potential risks.
- **Computer Vision and AI:**
  AI-powered systems can analyze video footage to assess posture, identify hazards, and suggest improvements.
- **Virtual and Augmented Reality:**
  VR and AR can simulate work environments, allowing for ergonomic assessments and training in a safe, virtual space.
- **Advanced Data Analytics:**
  Data analysis can reveal patterns and trends in workplace injuries, helping to proactively address ergonomic issues.
- **Ergonomic Software and Applications:**
  Software can be used to assess workstation setups, track employee movements, and provide personalized recommendations for improvement.

Benefits of Integrating High Technology with Ergonomics:

- **Increased Productivity:**
  Ergonomic technology can optimize ***workflows,*** reduce errors, and improve overall efficiency.
- **Enhanced Safety:**
  By identifying and mitigating ergonomic risks, technology can help prevent injuries and promote a safer work environment.
- **Improved Employee Well-being:**
  Ergonomic technology can reduce physical strain, improve comfort, and boost employee morale.
- **Better Product Quality:**
  In manufacturing, ergonomic improvements can lead to higher quality products by reducing errors caused by fatigue or discomfort.
- **Cost Savings:**
  By reducing workplace injuries and improving productivity, ergonomic technology can lead to significant cost savings for businesses.

Examples of High-Tech Ergonomic Applications:

- In manufacturing, robots and ***cobots*** can be integrated with ergonomic principles to assist workers with repetitive or ***strenuous*** tasks.
- In healthcare, wearable sensors and AI can be used to monitor patient handling and reduce the risk of musculoskeletal injuries for healthcare professionals.

- In offices, adjustable desks, ergonomic chairs, and software can be used to create comfortable and efficient workstations.

Future of Ergonomics and Technology:

The integration of technology and ergonomics is an ongoing process, with new innovations emerging regularly. As technology continues to advance, it will play an even more significant role in shaping the future of work and ensuring the well-being of workers

Vocabulary

Intertwined:

Safety:

Sensor:

Workflow:

Cobot:

Strenuous:

2. Enhancing capabilities: the role of exoskeletons

Exoskeleton makes workers 27 times more efficient

By Liz Stinson, September 2014
(Source: https://www.wired.co.uk/article/navy-exoskeleton-productivity)

Lockheed Martin created the FORTIS exoskeleton, which can boost worker productivity up to 27 times

Military work is physically demanding -- and we're not just talking about soldiers on the battlefield. Travel down the chain, and you'll find plenty of positions where strength and **stamina** are **highly valued skills**. Take the US Navy for example. The Navy needs ships and those ships need to be built and maintained -- a rough, **physically draining** job. **Sandblasting**, **riveting**, and **grinding** excess metal off the ships can **take a toll** on the human body. You're often carrying tools that can weigh upwards of 30 pounds. "There's a lot of **wear and tear** on you," says Adam Miller, director of new initiatives for Lockheed Martin. "Skilled workers can maybe do that for three to four minutes then they need to put the tool down and they need to rest."

For the past couple of years, **Miller has been leading a team of engineers and designers** to create one of the first industrial-use exoskeletons. Called the FORTIS, the exoskeleton is able to support tools of up to 36 pounds and transfer that load from a worker's hands and arms to the ground. The goal is to lighten workers' loads, **ultimately making them more productive and skilled at their jobs**. **The US Navy recently bought two of the exoskeletons and plans to test them over the next six months** to see how they might be used in an industrial situation.

Compared to something like the TALOS (Tactical Assault Light Operator Suit), a computerised exoskeleton that essentially wants to turn mere mortals into Iron Man, the FORTIS is fairly simple. "I would call it elegant," says Miller. The anodised aluminium and carbon fibre skeleton weighs 30 pounds, and follows along the outside of a human's body. It has joints in the parts of the body that would regularly have joints (ankle, knee, hip) and flexes from side to side at the **waist**. Miller says the skeleton was designed for complex environments -- whoever is wearing it can **climb** stairs or **a ladder**, squat and generally move **business as usual** in the exoskeleton.

Tools **mount to the fron**t of the FORTIS and that weight is directed through the joints in the hip and down to the floor, relieving stress on the entire body, including the feet and ankles.

Watch and learn

The design team began by watching how humans walk. "You have to look at biomechanics of the person because it's not just a stand; it's really something they can move around in," says Miller. The FORTIS was designed so it could **slip over** a worker's boot -- this is important since **feet often communicate the first signs of weariness**. It's like running in a pair of **crappy shoes**; it impacts your entire body. Many exoskeletons transfer that weight to the **sole of the foot**, but this is a problem, says Miller. "When the weight of the tools and exoskeleton itself is transferred **to the ground**, it comes to rest on the sole," he says. "However, a sole can also contribute to user discomfort, increased metabolic cost to the user and introduces instability." Instead, the FORTIS uses a **stirrup** that attaches to the ankle, allowing the foot to rest on the ground as usual.

Early tests show that the exoskeleton has increased productivity anywhere from two to 27 times, depending on the task. The team measured the amount of time a worker could hold a 16-pound **grinder** overhead without having to rest his arms. "The longest operators could work continuously without a break was three minutes sustained without **augmentation**," says Miller. "**Using the FORTIS, operators could work 30 minutes or longer without requiring rest breaks.**"

Lockheed Martin has been developing exoskeleton technology for the past five years. Its other exoskeleton, the HULC, is hydraulic-powered and can support up to 200 pounds. The HULC was designed to be used on the field, during battle. The FORTIS' capabilities are scaled down, but with its focus on mobility, you can imagine that it could be useful for other industries like construction or mining -- "anywhere there's a complex and irregular environment," says Miller. "We're expecting other industries to see it and say, 'We want something similar.'"

Vocabulary:

Stamina:

Highly value skills:

Draining:

Sandblasting:

Riveting:

Grinding:

To take a toll:

Wear and tear:

A waist:

To climb:

A ladder:

Business as usual:

To mount to the front:

To slip over:

Crappy shoes:

Sole of the foot:

Ground:

Stirrup:

A grinder:

Please answer the following questions:

1. What industry does Lockheed Martin operate in?

2. Does ship building and maintaining require hard work? If so, why?

3. Please search what 30 pounds are once converted in kg.

4. What has Miller’s team done?

5. Who has bought plan and samples of the FORTIS?

6. Please describe the FORTIS.

7. How did the design team work?

8. Does the FORTIS enhance workers’ capabilities? If so, how?

9. In your opinion, can we talk about augmentation?

3. Health and Safety

Health & Safety (issues, policy):

Health and safety legislation mainly **relates to** the workplace; it is based on **common sense** and **safe practice**. It places the **duty** on employers to take responsibility for the health and safety of their employees at work “as far as is reasonably practicable”.

> *“as far as is reasonably practicable”*

The responsibilities of the employer

- Provide and maintain safe systems of work.
- Provide adequate health and safety induction and training.
- Maintain safe work equipment.
- Ensure safe operation of working equipment.
- Ensure adequate welfare provisions are made.
- Provide a safe place of work. This includes safe **access and egress**.
- Ensure any materials are handled, transported, used and stored safely.
- Communicate with safety representatives.
- Provide PPE* or any other equipment needed in the interests of health and safety.

(PPE: Personal Protective Equipment)

Do employees have any responsibilities?

Yes, there are responsibilities for the employee too. Employees must:

- Take care of their own health and safety and that of others.
- Not interfere with any health hand safety equipment.
- Cooperate with employers.

→ In the UK, the HSE (https://www.hse.gov.uk/) regulates workplace health and safety. Its primary function is to prevent work-related death, injury, and ill health. HSE achieves this by developing regulations, providing guidance, conducting inspections and investigations, and enforcing laws. In France, the ANSES (Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail) plays a similar role.