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ERGONOMIC CHALLENGES AND EMERGING TECHNOLOGIES

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ABSTRACT:

Ergonomics is crucial in fostering healthier and more efficient workplaces. Ineffective ergonomic practices frequently lead to musculoskeletal injuries, responsible for nearly 55% of emergency room visits related to workplace injuries. These injuries not only affect the health of employees but also lead to decreased productivity and increased absenteeism. By tackling these concerns, a positive workplace culture can be cultivated, which minimizes turnover and enhances effectiveness. Hybrid work arrangements necessitate adaptable solutions, while innovations such as AI-powered tools and sustainable designs are reshaping how to engage with the workspace. These emerging trends not only help prevent injuries but also strengthen employee connections and foster settings that encourage concentration and relaxation. Workers of all ages are impacted by musculoskeletal diseases and chronic pain, which are addressed by ergonomic devices including supporting seats and footrests. Everyone can remain comfortable and productive with these solutions.

Managing a variety of demands in one workspace every employee can operate effectively if ergonomic instruments are provided that are suited to particular duties. Workspaces are changing to emphasise inclusivity, sustainability, and flexibility as a result of the ergonomic trends the emergence of AI-powered tools, portable ergonomics for mixed work, and environmentally responsible designs are important lessons learnt. By incorporating basophilic features and psychosocial ergonomics, these trends also highlight mental health. By implementing these improvements, occupational injuries are decreased and productivity is increased. Creating ergonomic workspaces encourages engagement, lessens weariness, and demonstrates your dedication to worker health. Emerging technologies including exoskeletons, wearable sensors, computer vision, artificial intelligence, virtual and augmented reality, and data analytics are altering how safety experts handle ergonomics. The Ergonomic Challenges of Today Are Being Met by Emerging Technologies Exoskeletons, for instance, are designed to lessen physical strain

and the chance of harm from things like difficult tasks, awkward postures, and small or constrained workspaces. AI powered smart technologies quickly adjust workplace to enhance posture and improve comfort level and productivity wearable technology encourages frequent movement and proper setting helps to stay healthy and prevent injuries. To protect environment and health choosing eco-friendly material like bamboo, providing comfortable and calm areas and customised work station improve productivity. Smart office chairs with sensors are dynamic for office setup and health focused environment. Incorporating nature that is using skylight and large windows can create peaceful and effective workstations.

Key Words: Ergonomics, sustainability, technologies, eco- friendly, AI-powered tools.

INTRODUCTION

Workplace safety and productivity are greatly improved by ergonomics, the science of creating products and environments that fit the human body. Ergonomics seeks to lower the risk of accidents and enhance general well-being by maximising the interaction between employees and their surroundings. Work system design has a significant impact on overall organisational success, safety, and productivity. The need to make sure that systems are developed with an emphasis on the human aspect is developing as workplace complexity increases as a result of workforce dynamics and technological improvements. A key component of this effort is ergonomics, the scientific field that studies how people interact with other components of a system.

Businesses can improve worker performance and reduce health and safety hazards by methodically incorporating ergonomic principles into the design of their work systems. This study examines how ergonomics can be included into work system design, emphasising how it can revolutionise a variety of industries. Aligning workplace environments with employees' physiological and psychological needs is one of the main goals of ergonomics in work system design. Ergonomics stresses a human- cantered perspective, making sure that systems take into account people's talents and limits, in contrast to traditional design approaches that place a higher priority on activities or equipment. This strategy not only lowers the risk of illnesses and injuries related to the workplace, but it also creates an atmosphere where workers may provide their best effort. Thus, ergonomics provides all-encompassing answers to workplace problems by acting as a link between engineering, psychology, and occupational health.

Use of Artificial Intelligence in Ergonomics: Through a variety of applications, AI can greatly improve workplace ergonomic assessments, resulting in more efficient ergonomic risk identification and reduction.

Automatic Analysis of Posture: Real-time video analysis of employees using AI-powered systems can detect dangerous postures and motions that could result in musculoskeletal disorders (MSDs). These systems identify and assess ergonomic risk factors such uncomfortable postures, repetitive actions, and excessive force using computer vision.

Wearable Sensors: Wearable gadgets with sensors and artificial intelligence algorithms

can track employees' biomechanical movements all day long. These tools can give employees instant feedback on their motions and posture, recommending changes in real time to lower ergonomic risk. Without the need for an in- person assessor, workers can enter information about their workstations, and AI algorithms can recommend changes for the best ergonomic configuration. AI-powered software can also perform virtual ergonomic assessments utilising digital models of the workplace.

Gain Access to Ergonomic Education and Training: AI- powered training initiatives can offer individualised instruction according to each worker's unique requirements and risk considerations. Gamified learning environments and interactive AI simulations can improve student engagement and ergonomics retention. AI may combine information from multiple sources, such as environmental monitors, sensors, and self-reports, to offer a thorough understanding of ergonomic hazards at work.

Patterns and correlations that conventional analytical technique can be found using advanced analytics.

Automation and Robotics: AI can direct the creation and implementation of robotic systems to help with or automate ergonomically hazardous tasks. Humans can work alongside collaborative robots (cobots), which can perform repetitive activities or difficult positions.

Tailored Ergonomic Solutions: AI algorithms are able to produce tailored suggestions for equipment, tools, and workstation configurations based on the physical attributes and task Organisations can improve ergonomic assessments' efficacy and efficiency by utilising AI in several ways.

Through utilising AI in these ways, companies may promote a safer, healthier, and more productive work environment in addition to improving the efficacy and efficiency of ergonomic examination s. In order to prevent injuries and promote employee well-being, ergonomics is essential. Musculoskeletal disorders (MSDs), which impact millions of workers worldwide and lead to pain, decreased productivity, and higher healthcare expenses, are one significant worry.

RULA: Ergonomists utilise RULA (Rapid Upper Limb Assessment) as a useful technique to promptly detect the dangers of upper limb MSDs (musculoskeletal diseases) at work. This approach is especially helpful in places where physical handling, repetitive tasks, and extended computer use are typical, such as offices, manufacturing facilities, and healthcare settings. Below is the first section of the RULA worksheet. Which positions carry more hazards are indicated by the joint angles and their corresponding RULA ratings.

RULA: Recognising and Evaluating Hazards when conducting an RULA evaluation, a number of characteristics pertaining to an employee's posture during work performance are observed and scored. These elements consist of:

Joint angles: To ascertain the amount of stress applied to various joints, such as the wrists, shoulders, and neck, the angles between those joints are measured.

Weight: Because it might cause strain, the weight of any things being handled is also taken into account. A score is given based on these variables, reflecting the degree of risk for MSD development. A limb's risk score increases with the degree of deviation from its neutral position.

Advantages of RULA: Use RULA implementation at work can result in a number of noteworthy advantages: Decreased injuries Recognising and mitigating ergonomic hazards reduces the likelihood of

Enhanced productivity: RULA can help create a more productive workforce by reducing discomfort and injury. **Increased employee happiness and morale:** A secure and cosy workplace can increase employee satisfaction and morale.

Manual RULA examinations have drawbacks despite their efficacy:

Time-consuming: Observation and scoring for manual evaluations take a lot of time.

Subjectivity: Depending on the viewpoint and experience of the assessor, results may differ.

Assumptions: The procedure is predicated on presumptions on the frequency and length of postures.

AI and RULA: An Effective Blend One technological development that is transforming ergonomics is AI (Artificial Intelligence) pose estimation. AI is used by programs such as Quick Pose to precisely assess a person's range of motion in multiple joints at once while they are working on a job.

Three surgeons are seen in the operating room in the picture below. AI pose detection is used to produce the lines on their bodies. The red lines indicate dangerous angles the surgeons are working in, while the green lines indicate a joint's safe range of motion.

Individually at-risk postures: If certain people exhibit high-risk postures on a regular basis, they could need specialised interventions, including ergonomics training or workstation modifications.

Systemic ergonomic problems: It is necessary to adjust the ergonomics of a specific region if data suggests that a sizable portion of workers at a given workstation adopt dangerous postures.

In terms of ergonomic assessment, quick Pose is at the forefront of customised AI technology. quick Pose, which was created to satisfy the particular requirements of different businesses, has several advantages:

- **Less Downtime:** quick Pose helps prevent work-related injuries by detecting risk factors early, which results in less time away from work.
- **Safer Workplace:** Proactive risk management and a culture of safety are fostered by on-going, real-time monitoring.

Scalability: QuickPose can be implemented at many locations and grows in size as the workforce does, guaranteeing uniform ergon omic evaluation for every worker.

Sustainable material used for ergonomics production: Recycled PET fabric, bamboo, and recycled plastic are environmentally beneficial materials for ergonomic gadgets. Plastic that has been recycled. It is a long-lasting substance with exceptional sound retention. Waste is decreased by using recycled plastic.

Bamboo

This is a robust and pliable substance with tensile strength greater than steel. Bamboo's mechanical qualities have been tested by industrial designers.

PET fabric that has been recycled composed of shredded single- use PET water bottles that would have otherwise ended up in landfills. After then, the yarn is turned into fabric, occasionally weaved with cotton or other fibres.

Eco-friendly design: Low-impact substances: materials that are non-toxic, made sustainably, or recycled and that process with minimal energy.

Energy efficiency: Energy-efficient manufacturing techniques **Sturdiness:** Improving a product's durability lowers waste of resources and consumption. Understanding sustainable materials in office furniture is becoming more and more crucial as environmental consciousness rises. Understanding what materials to look for will help you make ecologically friendly decisions without sacrificing quality or design, whether you're decorating a new workplace or remodeling an old space. The Environmental Protection Agency (EPA) asserts that minimising environmental impact requires sustainable materials management. In terms of office furnishings, this comprises: For environmental responsibility, selecting workplace furniture made of sustainable materials is essential. The ultimate in sustainability is represented by refurbished furniture, which offers premium, eco-friendly solutions that blend the best materials with longer product lifespans. Take into account the materials used as well as the overall environmental impact when choosing workplace furniture. Refurbished chairs like as the Human scale Liberty or Herman Miller Aeron provide the ideal fusion of high- quality construction, environmentally conscious design, and sustainable materials. In addition to adorning your office, you're investing in the future of our planet by selecting refurbished furniture made of sustainable materials, which also offers superior quality and ergonomic design.

1. Materials that have been recycled
2. Resources that is renewable
3. Biodegradable substances
4. Materials with low emissions
5. Materials sourced locally

Durable upholstery; eco-friendly leather substitutes; and recyclable metal parts seating for Guests.

Pay close attention to:

- Materials that is easy to clean;
- Durability for heavy use
- Modular design for replacing parts

PROS and CONS

Among the many advantages of ergonomic workstation design are increased output, fewer mistakes, and greater worker health.

Advantages

Better posture Good posture is encouraged by ergonomic workspaces and can enhance both mental and physical well-being. Decreased mistakes when workers have pleasant workplaces, they are less likely to make mistakes. A rise in output Comfortable workplaces can result in higher-quality output and faster task completion.

Decreased absences: Workers who are in good health are more likely to stick with their occupations.

Decreased musculoskeletal conditions: Costly musculoskeletal disorders (MSDs) can be avoided with the aid of ergonomic workstations.

Enhanced contentment at work higher job satisfaction is reported by workers in offices with ergonomic designs.

Cons

Workers that have to move around a lot could be less motivated and focused.

Workers may be more susceptible to physical and mental health problems if they operate in ergonomically poor workplaces.

By supplying resources, tools, and information in an ergonomic manner, ergonomic workstations can also aid in workflow optimisation.

CONCLUSION

This article examines the critical role of ergonomics in enhancing workplace health and productivity. It identifies emerging trends for 2025, such as AI-powered tools, wearable devices, eco- friendly materials, and adjustable furniture that are transforming work environments. The discussion extends to the integration of technology in ergonomic practices, the emphasis on sustainability, and the advantages of customizable workspaces in promoting employee well-being.

Ergonomics is a philosophy of work system design as well as a science. That honour and improve human potential. This study emphasises how crucial it is to creating inclusive, productive, and safe workplaces.

Businesses can strike a healthy balance between employee well- being and operational effectiveness by investing in ergonomic principles. Future attempts to include ergonomics into work system design will be built upon the human-centered and sustainable style of working.

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