THE IMPACT OF ERGONOMICS

ON PRODUCTIVITY, LEAN PROCESSES, AND WORKER WELLBEING

BOSTONtec

Ergonomic Workstations

Zone 4
Storage for minimal use items
Zone 3
Less accessible for low use items
Zone 2
Comfortable access to medium use items
Zone 1
Easy access to high use items

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INTRODUCTION

Over the years, various ergonomics studies have shown that ergonomically designed desks and chairs can improve worker wellbeing and productivity in office environments. Can the same be said for ergonomic workstations in the industrial sector? As a leader in ergonomic industrial workstations, BOSTONtec contracted The Ergonomics Center at North Carolina State University to conduct a study for the industrial environment. The goal was to find out if there were quantifiable differences between workstations with ergonomic features and those without.

This white paper will further explore the impact of ergonomics on productivity, lean processes, and worker wellbeing. Ergonomic workstations can be implemented into industrial work processes to increase productivity, reduce risks, address worker health issues, and save the company money. Integrating ergonomic principles into work processes does not have to be a challenge and can reap considerable benefits.

This white paper will explore the impact of ergonomics on productivity, lean processes, and worker wellbeing. Integrating ergonomic principles into work processes does not have to be a challenge and can reap considerable benefits.

STUDY DESIGNED AND CONDUCTED BY:

JEFF HOYLE
DIRECTOR OF ERGONOMIC SERVICES
THE ERGONOMICS CENTER

ergocenter.ncsu.edu

The Ergonomics Center

WHAT IS ERGONOMICS AND WHY IS IT IMPORTANT?

Ergonomics is the science of designing the workflow of a task to fit the individual worker. It recognizes that every employee is different in terms of height, weight, strength, and length of reach. It does not operate on the principle that the worker should fit the task. Instead, employers should implement measures that allow the worker to complete their task comfortably and effectively without having adverse long-term effects on their health or the company's bottom line.

Overall, ergonomics has two aims:

1. ***Improve employee wellbeing and***
2. ***Optimize performance.***

The industrial workforce is evolving. There is no "average" worker, with everyone varying in size, age, and strength. With increased workforce diversity, a "one size fits all" workstation is insufficient. The differences in the workforce need to be accommodated with a workstation with customizable ergonomic features, including height-adjustability, arm and rail systems, accessories for computers, lighting, and support for tools.

By implementing ergonomic solutions into industrial work processes, companies will be addressing common worker health problems and dissatisfaction, and increasing efficiencies. These solutions can save the company money, improve worker productivity, decrease absenteeism, improve product quality, and boost morale. Below, we examine the most common ergonomic issues industrial companies face.

"The industrial workforce is evolving. There is no 'average' worker. With increased workforce diversity a 'one size fits all' workstation is insufficient."

THE ECONOMICS OF ERGONOMICS

Jobs in manufacturing plants and warehouses often require repetitive motions that can cause work-related musculoskeletal disorders (WMSDs). WMSDs are injuries and disorders of bones and soft tissues caused by repetitive movements, overexertion, and awkward positions. These workplace injuries account for almost 40% of injuries in the workplace and cost U.S. businesses over $20 billion a year, according to the 2020 Liberty Mutual Workplace Safety Index. If the problems are not addressed, injuries will continue to happen. The World Health Organization has projected that the number of people suffering from WMSDs will increase as the population ages and grows.

Because WMSD injuries are preventable, companies can decrease these injuries by taking actions. One company working to improve the rate of WMSD cases is Amazon. In his final letter to shareholders, CEO Jeff Bezos stated that they recognize how lack of ergonomic principles is causing several problems for the workers. Therefore, it is Amazon's goal to take measures to decrease WMSD injuries in their warehouses by half.

If workplace health issues are not addressed with preventative, ergonomic measures, companies could face the following indirect costs:

- Accident Investigations
- Loss of Productivity
- Turnover & Absenteeism
- Quality Control
- Training & Re-training

THE ECONOMICS OF ERGONOMICS

Worker retention is a significant concern for employers because it costs time and money to train employees. There are several direct and indirect costs from not addressing the impact of ergonomics. Direct costs include offering workers compensation and covering medical and legal expenses from poor working conditions. However compared to indirect costs, direct costs are just the tip of the iceberg. The majority of the costs are indirect and result from training replacements, investigating accidents, lost productivity, lower employee morale, and increased turnover.

Costs of WMSDs

Indirect Cost of WMSDs are up to FIVE times the direct costs

DIRECT COSTS	Workers comp, medical & legal expenses
INDIRECT COSTS	Training replacement, accident investigation, lost productivity, lower employee morale & turnover

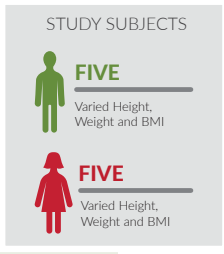
By improving the work environment and caring for workers' health and safety, employees will be more willing to stay with their current employer. Additionally, their improved work environment will enable them to perform at their best, decreasing the number of poorly made products, eliminating process wastes, and reducing the costs related to lost productivity.

ERGONOMIC STUDY

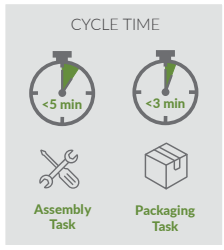
HOW ERGONOMIC WORKSTATIONS IMPROVE PRODUCTIVITY AND REDUCE RISKS

The study from *The Ergonomic Center at North Carolina State University* set out to evaluate if there are quantifiable benefits from using workstations with ergonomic features versus workstations that do not.

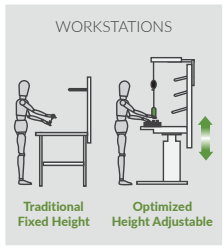
The Ergonomics Center



The study examined the assembly and packaging tasks of 10 different industrial workers—five male subjects and five female subjects, all with varying heights, weights, and BMIs.



During the experiment, the workers performed an assembly task using ten bolts and ten washers. They also performed a packaging task in which they assembled a small box, placed bubble wrap and an item in the box, taped the box closed, put the small box in a larger box, and then sent the box down the operation line.



The study evaluated workers' productivity time, their motion, and any ergonomic risks. To do this, they compared the work results performed at a traditional fixed-height workstation with those performed at an optimized height-adjustable workstation.

ERGONOMIC STUDY

HOW ERGONOMIC WORKSTATIONS IMPROVE PRODUCTIVITY AND REDUCE RISKS

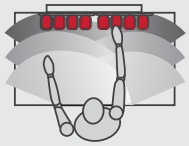
PRODUCTIVITY

Time Study
Measure Cycle Time Differences

MOTION

Motion Study
Total No. of upper extremity motions
No. of upper extremity value-added motions
No. of upper extremity non-value-added motions

ERGONOMIC RISK



Ergonomic Study
Ergonomic Risk:
No. of reaches outside of acceptable reach zones
RULA scores - risk differences

This ergonomic study showed a reduction in cycle time and an increase in value-added motions when the optimized height-adjustable workstation was used.

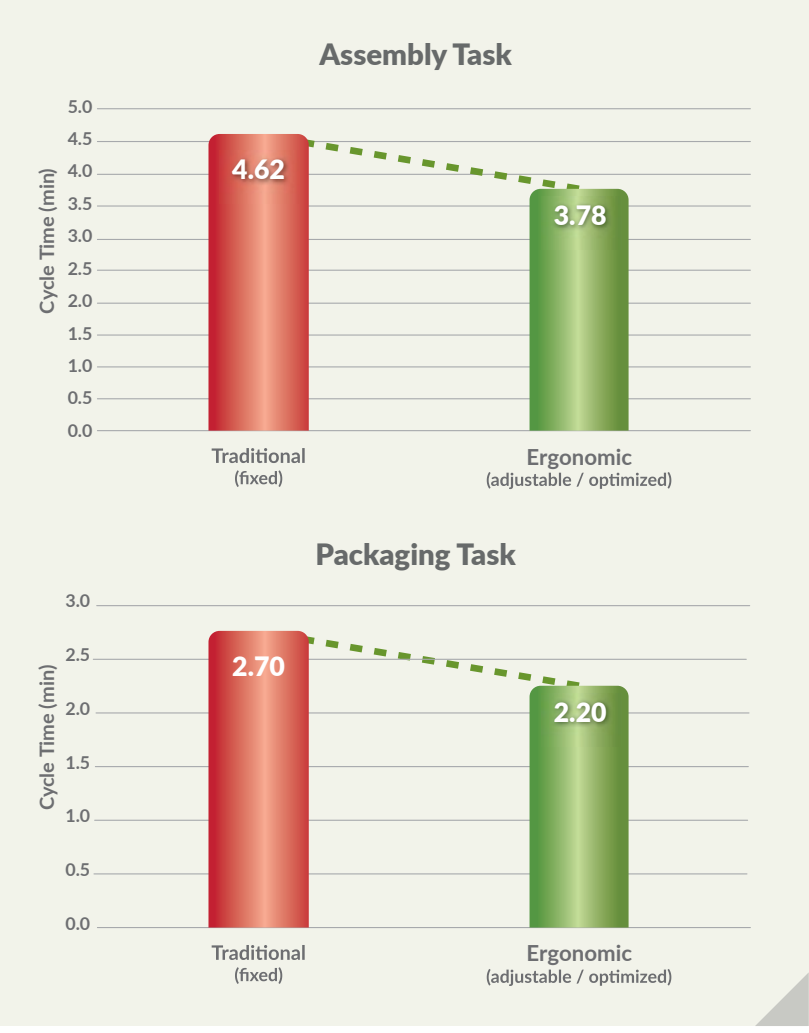
There is clear evidence to support the need to focus on ergonomics in the industrial sector.

The study revealed several improvements, including shorter cycle time, more value-added motions, and fewer chances for injuries.

IMPROVE CYCLE TIME

In both the assembly task and the packaging task, workers performed more efficiently with an ergonomically optimized height-adjustable workstation than a traditional, fixed workstation. In fact, there was about an 18% improvement in cycle time. With the ergonomic workstation, it took workers 2.20 minutes to complete the packaging tasks and 3.78 minutes to complete the assembly tasks, compared to 2.70 minutes and 4.62 minutes, respectively, from the traditional workstations. Reduced cycle time helps companies boost their output and make their processes more efficient. Businesses can see significant benefits from considering ergonomics in their planning and purchasing decisions because it can directly impact cycle time and increase throughput.

Cycle Time by Workstation Type

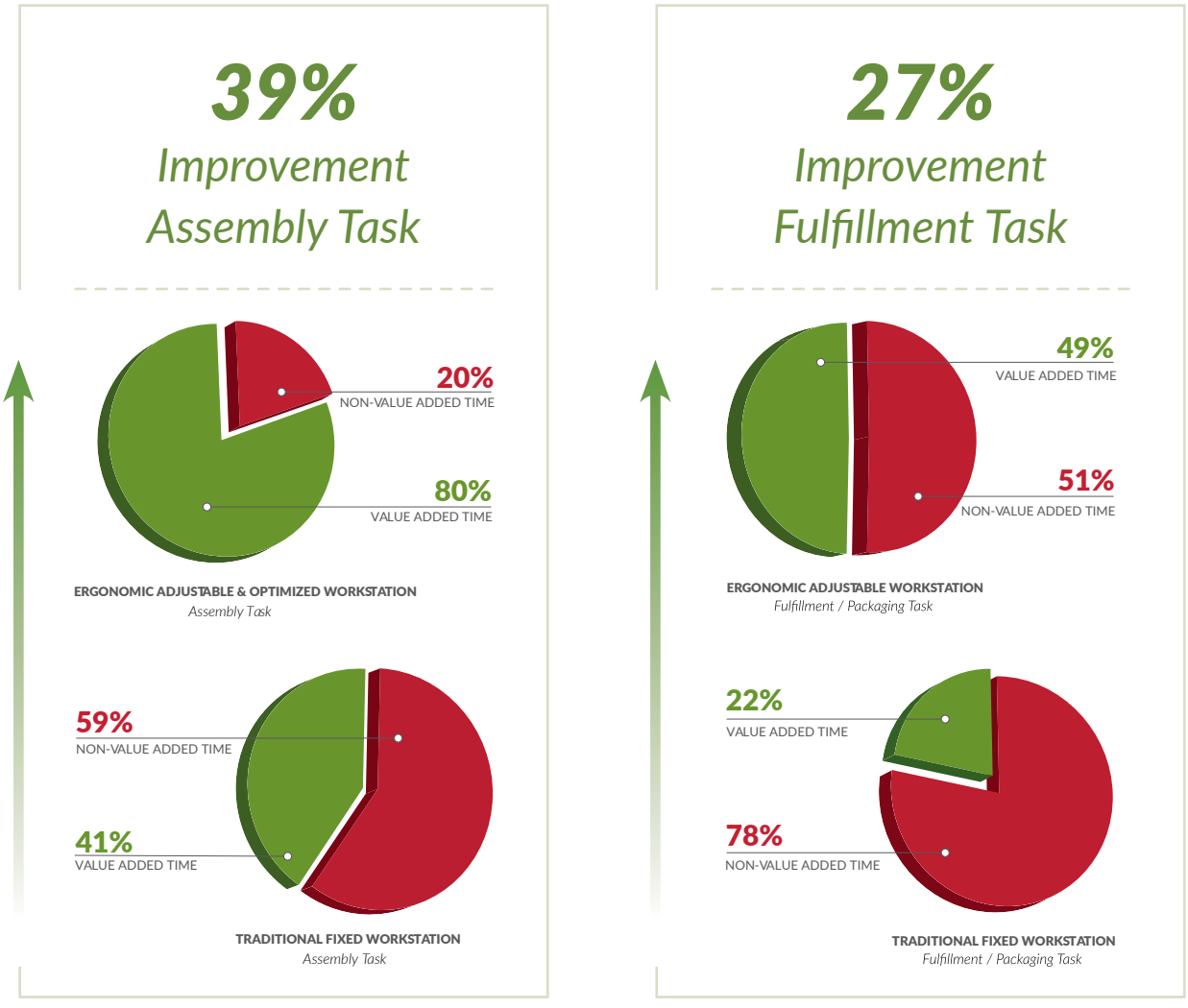


18%
Cycle time Reduction

SUPPORT LEAN PROCESSES

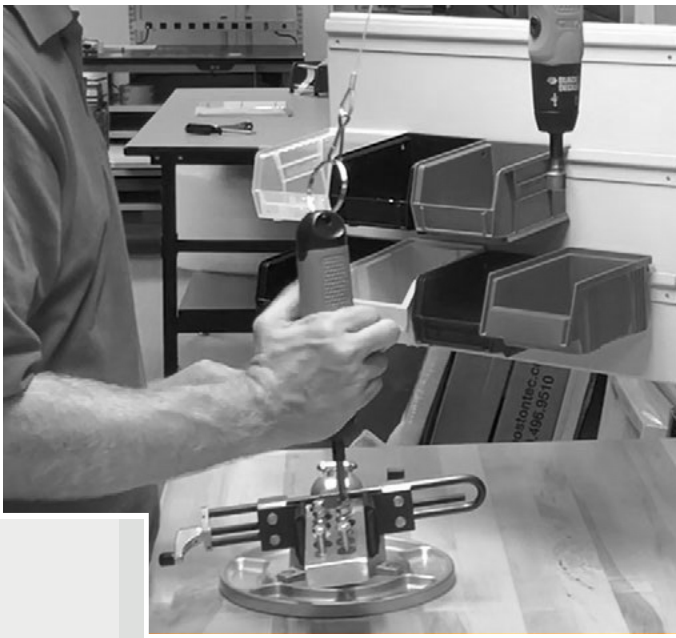
In addition to cycle time, the Ergonomic Study also looked at the effects on lean processes. Could ergonomics have a significant impact on a process's LEAN Analysis? The study showed that ergonomics increased value-added motions. Value-added motions are motions that change the form or function of a product, and the customers are willing to pay for this change. The study also showed that work completed using fixed, non-optimized workstations had increased non-value-added motions, which are the movements of a worker that would be considered "waste," such as the effort to look for a washer or nut. Overall, the ergonomic adjustable workstations saw a 27% improvement in a LEAN Analysis for the packaging task and a 39% improvement for the assembly task.

Lean Analysis by Workstation Type



SUPPORT LEAN PROCESSES

Non-value-added movements extend cycle time, decreasing the efficiency of processes. An ergonomic workstation shortens cycle time by making it easier for workers to complete their tasks. This type of workstation offers more organization, adjustable heights, and extendable arms and accessories, so all tools and parts needed to complete a task are within reach, creating more lean workflows.



An ergonomic workstation shortens cycle time by making it easier for workers to complete their tasks.

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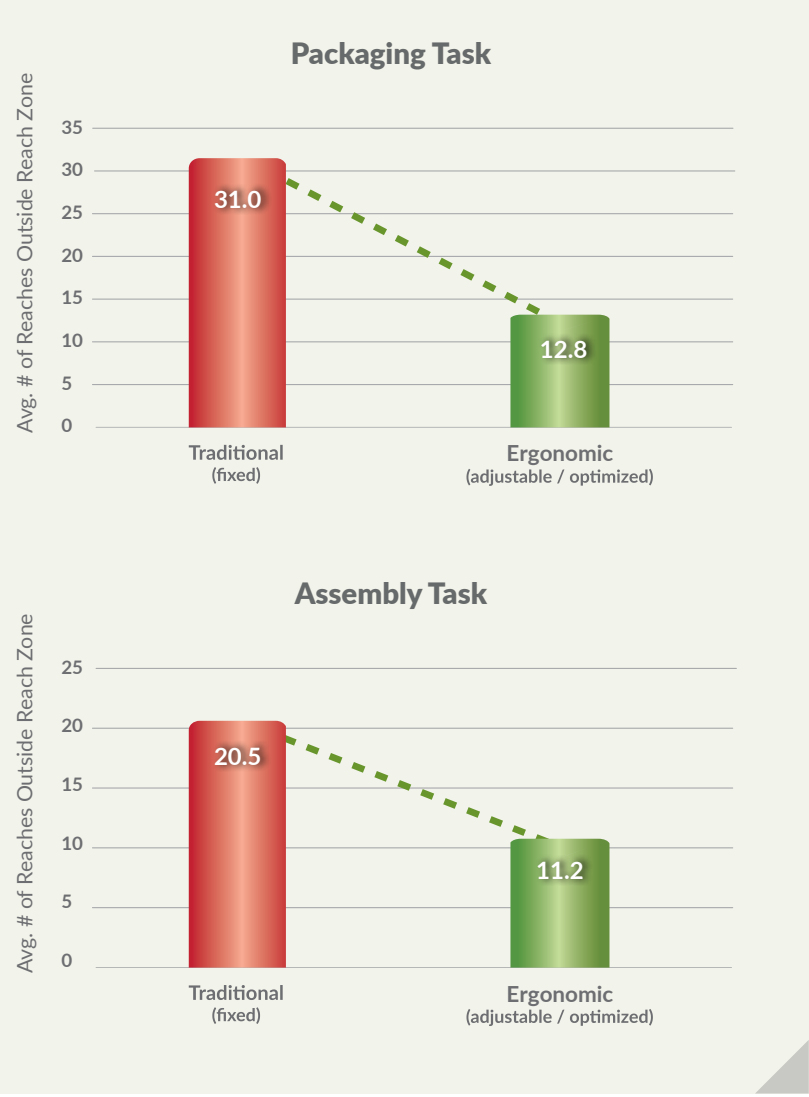
REDUCE ERGONOMIC RISK

The results of the Ergonomic Study also showed that an adjustable and optimized workstation reduced the number of reaches workers had to make outside of acceptable reach zones. For the packaging task, there was a 59% improvement. For the assembly task, there was a 46% improvement.

Ergonomic Risk (via Reach Zones)

by Workstation Type



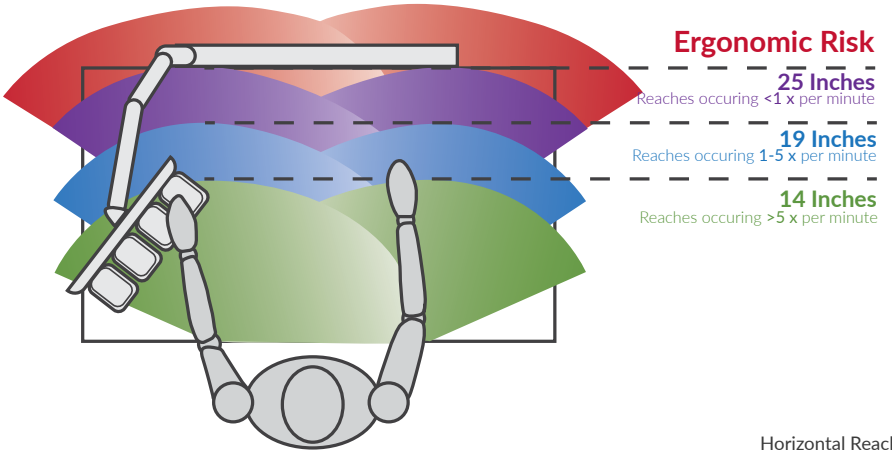
59%
Improvement

46%
Improvement

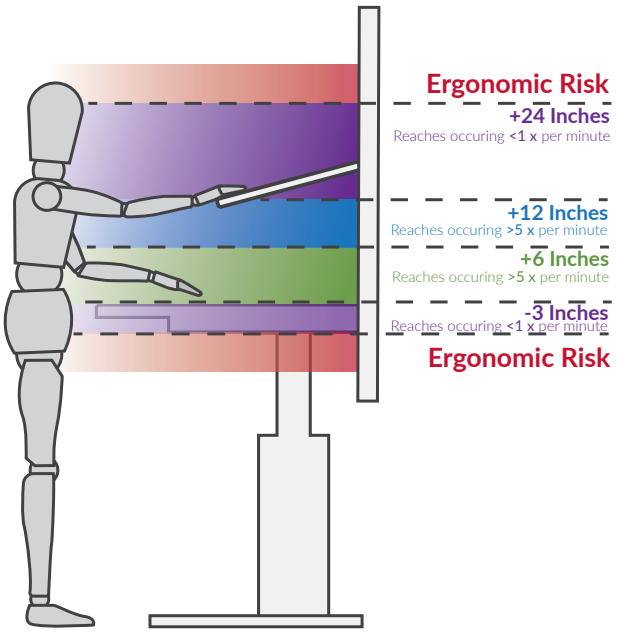
REDUCE ERGONOMIC RISK

Reaches Outside of Acceptable Reach Zones

Vertical and horizontal reaches that fell outside of these acceptable reach zones (given frequency) were counted and recorded in the ergonomic study.



Horizontal Reach Zones



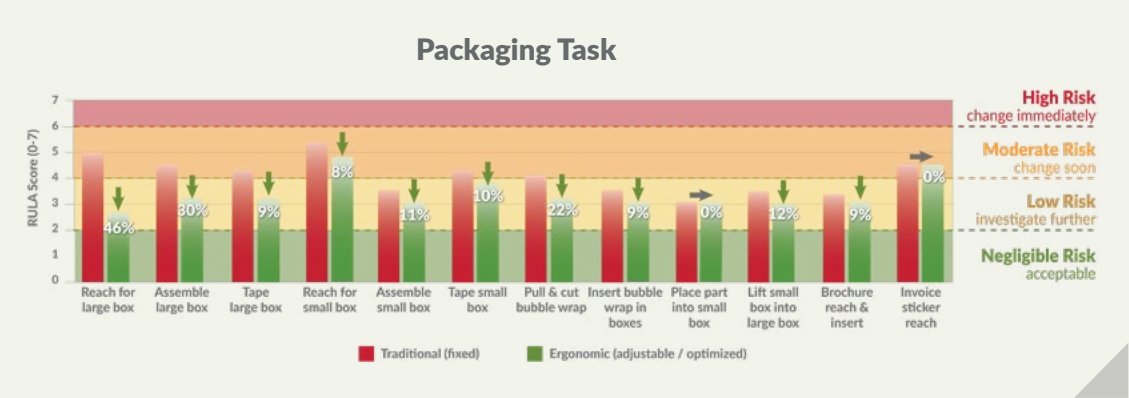
Vertical Reach Zones

REDUCE ERGONOMIC RISK

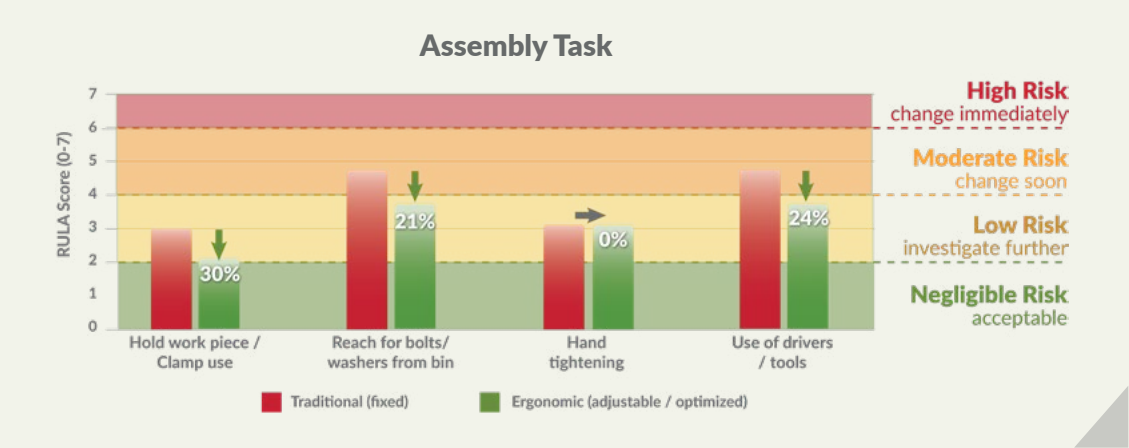
In terms of RULA scores (Rapid Upper Limb Assessment), an ergonomic workstation enabled a worker's reach to stay within the Low Risk to Negligible Risk range. In contrast, the fixed workstation caused many reaches to fall within the Moderate Risk to Low Risk range.

By offering ergonomically designed workstations for industrial workers, organizations will be facing fewer costs associated with ergonomic risks, such as injuries and strains. When employees are not suffering from injuries or pain, they'll be more likely to show up for work and perform accurately and efficiently.

Ergonomic Risk (via RULA Scores) by Workstation Type



up to **46%** Improvement



up to **30%** Improvement

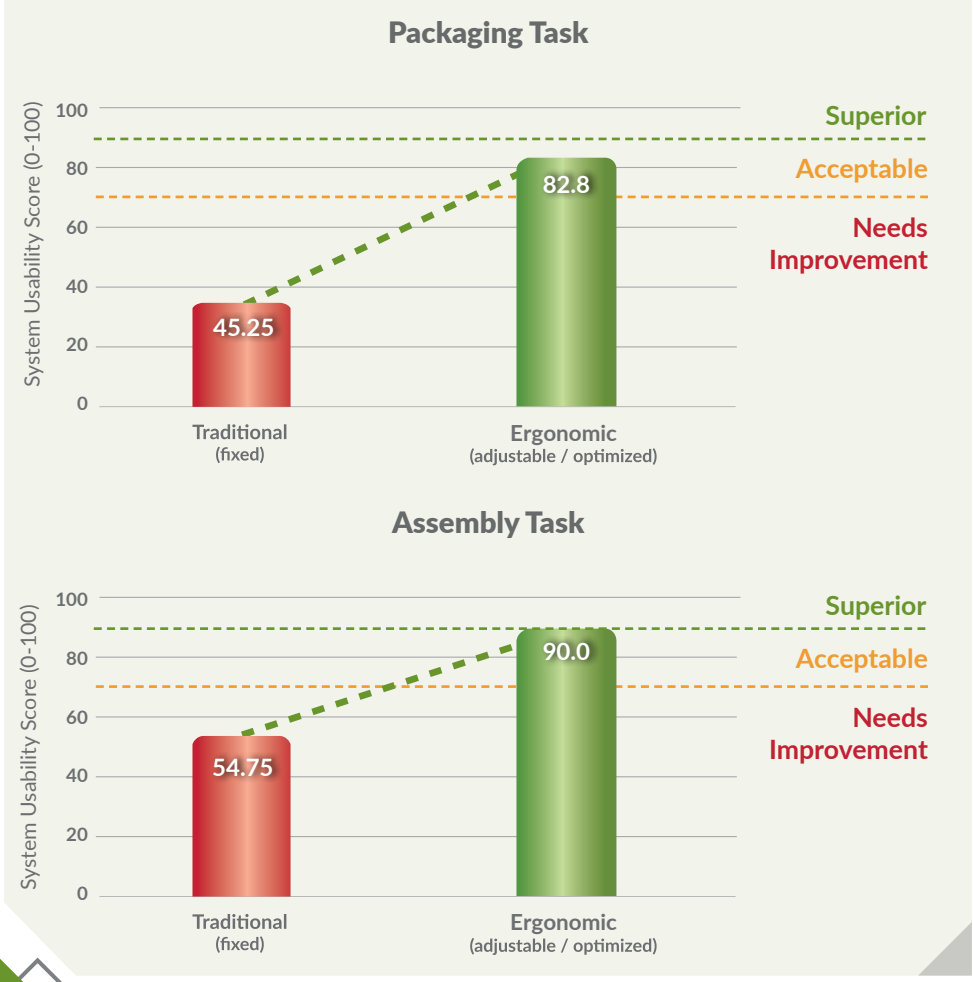
INCREASE USABILITY

Along with testing the difference in reach zones between the two types of workstations, The Ergonomic Center also tested the workstations' System Usability Scores. The ergonomics workstation outscored the fixed workstation in both the assembly task and the packaging task, with its score landing in the Acceptable to Superior range. The score for the traditional workstation landed in the Needs Improvement classification in both tasks.

Workstations that include ergonomic features, such as extendable arms and adjustable heights, make it possible for a more diverse group of employees to complete their tasks efficiently. Worker productivity is increased when their stations are designed with ease-of-use in mind.

Ease of Use (System Usability Scale) by Workstation Type

Classifications as suggested by Bangor et al., 2008



76% Improvement

64% Improvement

LOWER CHANCES OF INJURY OR HEALTH PROBLEMS

Working at fixed workstations with poor ergonomic features causes repetitive movements and poor postures that can adversely affect workers' health. Because ergonomic workstations shorten reaches and improve usability, there are fewer chances of injury and health issues in a worker's life.

This type of workstation also accommodates an aging workforce. Employees are working longer, meaning strengths, lengths of reach, and pain tolerance levels are more diverse than ever. To support their workers and protect their health (and, therefore, their number of productive years), companies are well advised to replace fixed workstations with ergonomically designed, adjustable height stations.

BOOST SATISFACTION AND EMPLOYEE RETENTION

At the end of the study, each participant was given a survey. They were instructed to select between the two workstations when answering a series of "I prefer the following workstation type to help me..." questions. No worker preferred the traditional, fixed workstations over the adjustable ones for any performance questions. The ergonomic workstation was chosen when the workers were asked about performing tasks more safely, easily, faster, and with less effort.

The survey results indicate that workers will be more satisfied if they can work at stations with ergonomic features. Because they'll perform their jobs better, they'll feel a sense of pride in the work they produce. In the end, they'll be more loyal to their employers. Companies will then be benefiting from lower turnover rates and absenteeism. Paying attention to ergonomics likely improves the quality of the products produced by employees if they are more satisfied and less stressed or overworked.

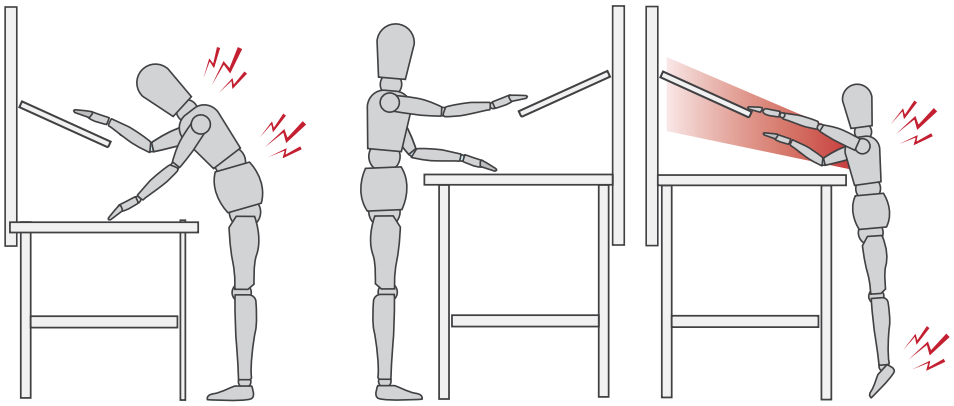
ERGONOMIC PRINCIPLES TO IMPLEMENT

Improving productivity, lean processes, and worker wellbeing can begin with implementing ergonomic principles in workstations throughout the company. Height-adjustable workstations, monitor arms, color-coded systems, and LED lights are just a few of the tools businesses can use to incorporate ergonomics into work processes. The following principles can guide an ergonomics strategy:

- **Optimizing Positions**
- **Eliminating Extreme Movements**
- **Minimizing Repetitive Motions**
- **Ordering and Color Coding**
- **Optimizing Lighting**

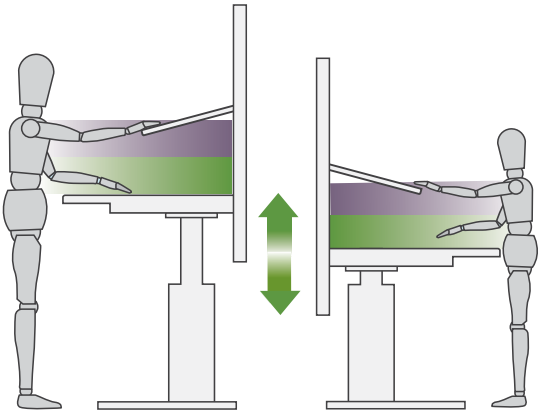
OPTIMIZING POSITIONS

The fact that workers come in all shapes and sizes demands multi-shift, multi-operator processes to adjust to the diverse workforce. A fixed workstation could be the perfect height for one employee but too low or too high for other employees. The workstation height issues cause workers to make frequent unnatural movements such as bending, stretching, or reaching. Electric height-adjustable workstation can easily be adjusted with a push of a button and can prevent these risky motions. It allows workers to stand in neutral positions with minimal risk of injury.



Danger Zone: Bending, Stretching and/or Reaching

Challenge: Multi-Operator processes with varying heights



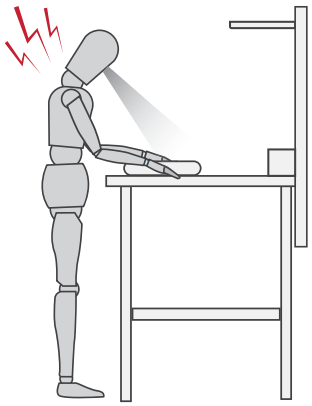
Neutral Position: Most operators stay in 1st and 2nd zone

Solution: Height-adjustable workstations

OPTIMIZING POSITIONS

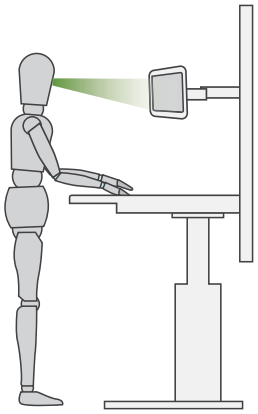
Another typical ergonomic challenge of non-ergonomic workstations, is the fact that workers frequently bend their necks to look down at instructions or documentation. This repetitive movement can lead to neck, shoulder, and upper back pain. Ergonomic monitor arms are a good solution to position screens level with the workers' eyes, ensuring a neutral position.

Additional solutions are extendable arms, keyboard trays, and other accessories that support an ergonomically sound workstation design.



Danger Zone: Neck bending

Challenge: Position of work instructions or other documentation

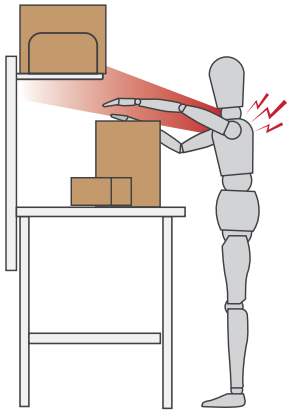


Neutral Position: For body and neck

Solution: Use monitor arms to position screens in correct height

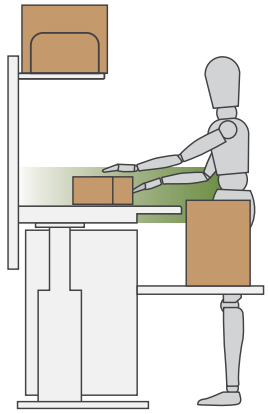
ELIMINATING EXTREME MOVEMENTS

Many fixed workstations are set up in a way that creates extreme motions for most of the workforce. Repeated reaches above shoulder height risk injuries to the upper back and shoulders. Frequent bending down at the hips and waist to grab materials may hurt back or legs. Specialty accessories and custom solutions can prevent workers from making such extreme movements: Ergonomic workstations with lower pull-out shelves for example can keep arms under shoulder height when doing tasks such as building boxes or printing documents. Specialty holders, such as spools for bubble wrap, can keep the worker's body upright at a neutral position.



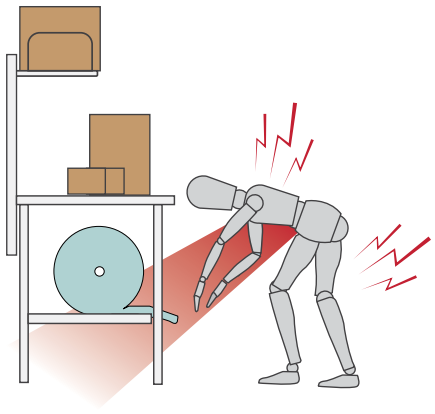
Danger Zone: Reaching above the shoulder

Challenge: Box building and packaging of large boxes on work surface



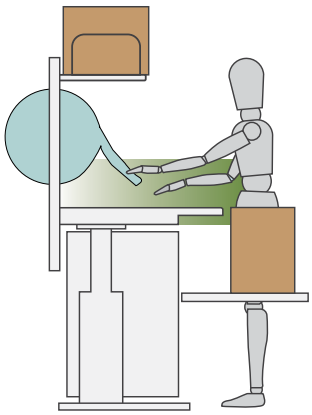
Neutral Position: Keeping arms under shoulder height

Solution: Under work surface shelving system



Danger Zone: Bending hips and waist

Challenge: Store packing material under work surface

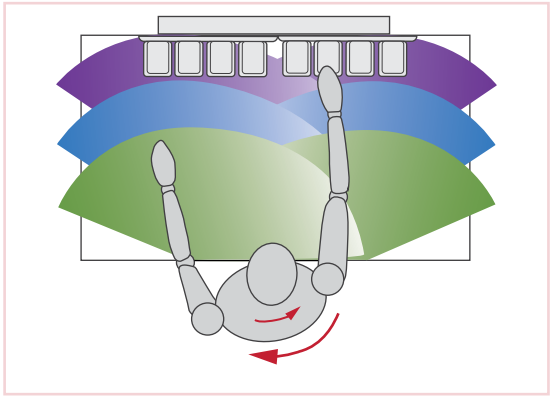


Neutral Position: Allows the body to remain upright

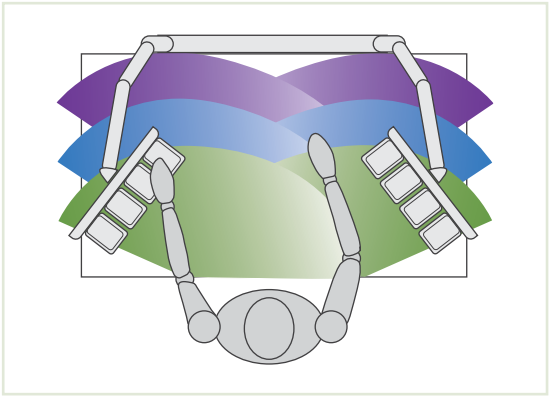
Solution: Specialty holders / spools

MINIMIZING REPETITIVE MOTIONS

Repetitive motions put a strain on a worker and can cause WMSDs. Traditional workstations often have shelves and containers at the back of the workstation. In this position, workers have to reach and twist their bodies at unnatural angles to complete their tasks. Workstations designed with ergonomic features such as arm and rail systems bring items into a safe reach zone for the individual worker.

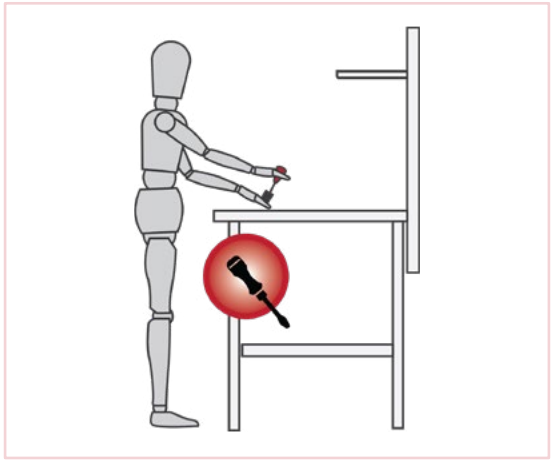


Challenge: Frequently used items for repetitive tasks placed at the rear of workstation. Forces the operator to reach and twist to Reach Zone 3.



Solution: Arm and rail systems bring items into Reach Zone 1

Workers' hands and wrists are also at risk of injury from repetitive motions such as screwing in bolts with manual tools. Workstations outfitted with powered tools and balancers can minimize the need for repetitive hand and wrist exertions.

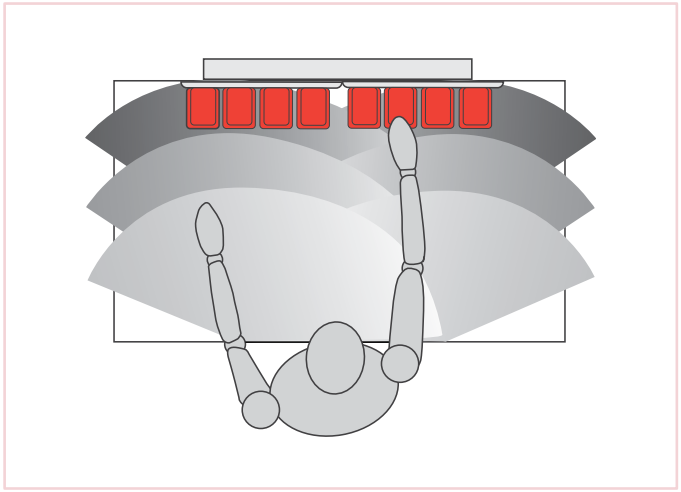


Challenge: Repetitive motions using manual tools w/o support

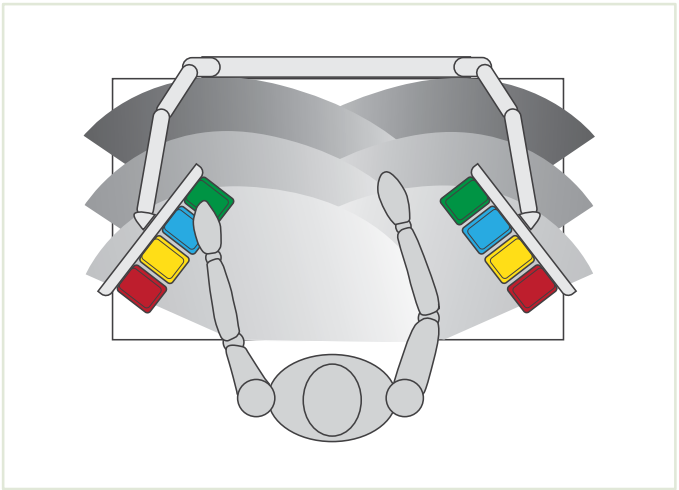
Solution: Powered tools and balancers

ORDERING AND COLOR CODING

Implementing ergonomic principles into work processes is not just about preventing and minimizing injury; it's also about improving productivity and accuracy. Color-coded bins and labels can help with sequencing and organization. Whether the employee is new or has been at the job for several years, the color-coded system will help them remember the locations of each supply, and the order in which that supply is needed.



Challenge: When a variety of items are needed for work processes, uniform color of bins challenges productivity and accuracy.



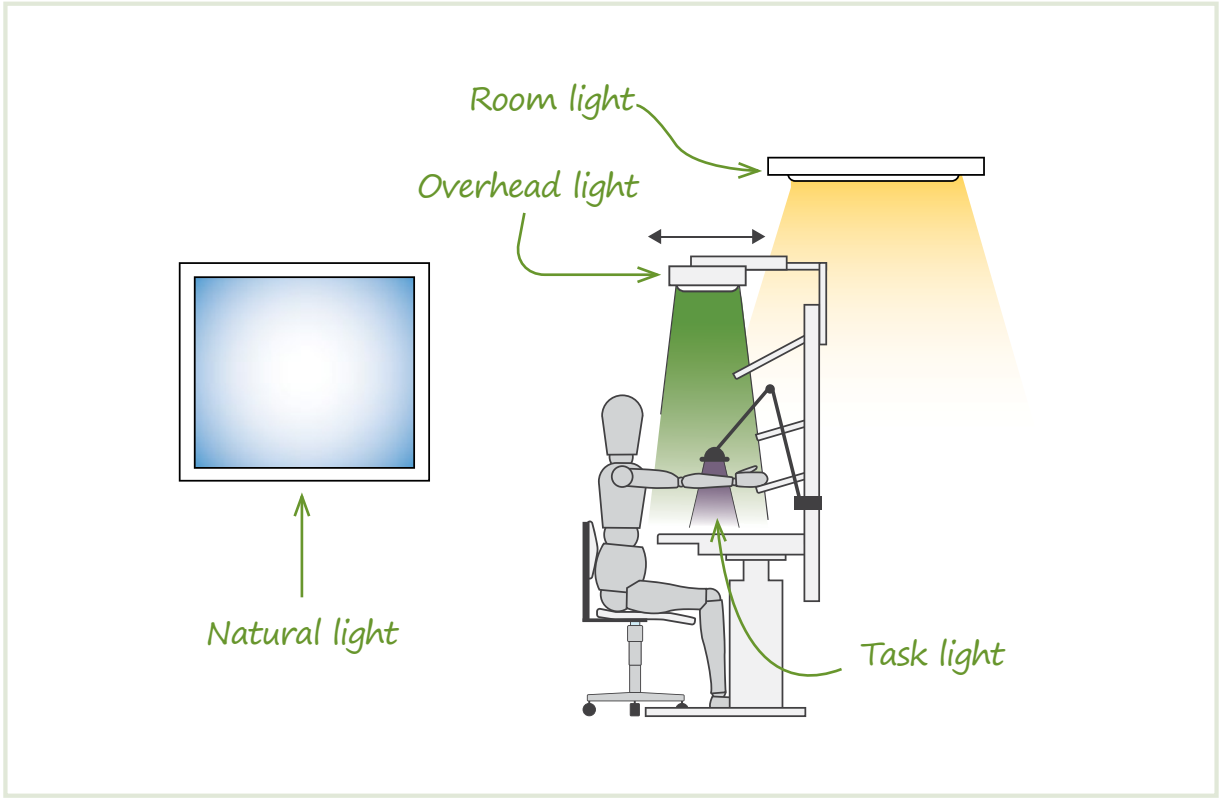
Solution: Clear color coding and labeling

The order principle is like how one would read a book, from left to right and top to bottom. Employers and employees alike can feel confident that quality products are being assembled.

OPTIMIZING LIGHTING

Ergonomics is not just about worker motions; lighting plays a significant role in worker productivity and wellbeing. Poor lighting causes eyestrain, headaches, fatigue, and, in industrial settings, can cause accidents if workers can't see tripping hazards or other potential dangers.

Proper lighting does so much for worker productivity and mental wellbeing. Workstations designed for ergonomics should feature overhead and task lighting in addition to the room's lighting and natural lighting, if possible. Task lighting is especially crucial for accuracy and quality of tasks in many manufacturing environments. Employers should consider utilizing LED lights because LED light fixtures have a white light that mimics daylight. This enables LEDs to fight worker fatigue and boosts productivity. Additionally, LED lights enhance worker's color perception, reduce maintenance costs, and improve energy consumption.



Workplace light sources: Natural, room, overhead, and task lighting

HOW TO PLAN AN ERGONOMIC WORKSTATION

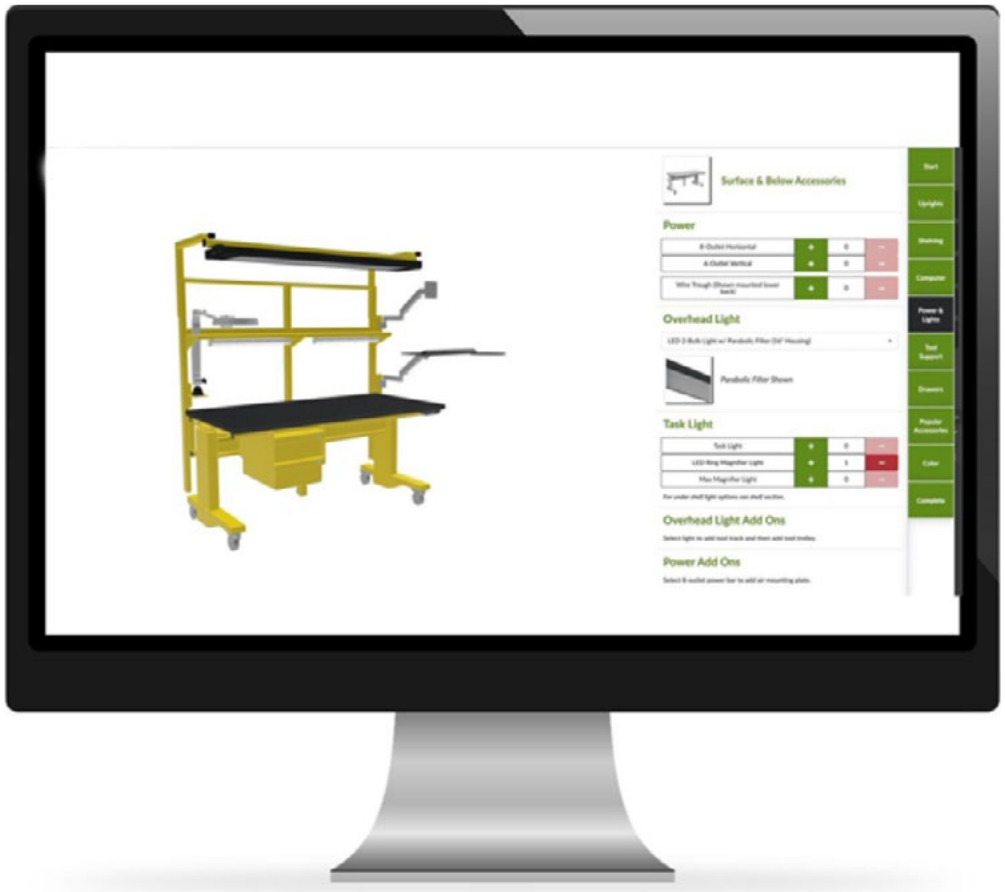
To improve productivity, lean processes, and worker wellbeing with ergonomic principles, you need to take the time to plan out the design that works best for your operations. BOSTONtec has broken down this pre-planning stage into seven steps in our Plan Your Workstation guide. Define the purpose of your workstation, determine workflow, plan the layout, and review the material handling process using our guide. If you would like help designing your workstation, BOSTONtec specialists will assist you through the process.

PLAN YOUR WORKSTATION CHECKLIST

Define the Purpose		
What is the function of the workstation?		
What tasks need to be performed?		
Determine Workflow		
How are orders/items being received?		
What is the process once items are received?		
How are orders/items exiting the station?		
How will materials be replenished?		
Inventory Items		
Tools		
Test and process equipment		
Components		
Product		
Reference materials		
Assign Priorities		
Frequency of use		
Sequence of use		
Accuracy required		
Duration of use		
Safety		
Force needed		
Convenience		
Plan the Layout		
Assign all items on the workstation inventory list to the appropriate ergonomic reach zone		
Establish workstation type: size, capacity, height adjustability		
Future considerations: adaptability to future needs		
Review Material Handling Process		
Moving material to perform the task into and out of the workstation		
Moving the product on which the task is being performed into and out of the workstation		
Material handling vehicles (carts, containers, conveyors, ball transfers)		
Conveyor routing for best material movement		
Ease of loading and unloading from conveyors. Are conveyors at the appropriate height?		
Material handling containers and tote sizes (in relation to quantities of material for the task, and weight, to eliminate heavy lifting)		
Evaluation and Review		
Monitor workstation usage for opportunities to improve		

3D CONFIGURATOR

Evaluating products online can be challenging because details can be difficult to visualize. BOSTONtec has created an easy to use 3D Configurator tool so you can get a 360-degree view of a workstation and its features. The configurator has over 90% of BOSTONtec's standard options and accessories, so you can quickly design your modular station that meets your needs.



CUSTOM WORKSTATIONS

Industrial custom workstations can give the optimum fit for your work processes. While BOSTONtec ergonomic workstations are highly modular and configurable to meet most industrial needs, custom solutions are the best option when you strive for the perfect fit between the workstation and its many users.

It's impossible for standard workstations and accessories to cover every need in diverse work settings. Companies who truly embrace ergonomics go beyond standard products and aim for more than just "good enough." Custom industrial benches can be the right solution if you have either an unusual work process, or you want to take your productivity, quality, and worker well-being to the next level.

Custom workstations are more affordable and conveniently available than you may think. Below are a few examples of workstations and benches that have been customized for very specific tasks:

The custom manual height adjustable workbench sits perpendicular next to the conveyor as a part of the assembly operation. A section of the rollers on the conveyor is replaced by pneumatic ball transfers to ease the movement of heavy load from the conveyor to the workstation. Left part of work surface is also equipped with ball transfers. Once the load lands on the workstation, the balls can be lowered making it a stable work surface for the operator to work on.

This electric height adjustable workstation was built for one of America's most successful and forward-thinking online retailers. It includes ergonomic features such as custom cutouts, trays, pull-out shelves, and side panels for easy accessibility of materials and equipments. It minimizes the strain and improve the productivity of the operators.

CUSTOM WORKSTATIONS

This versatile custom standing workbench is used in combination with a conveyor. It can serve as one of the stations in a progressive assembly setup. After the operator completes a specific task directly on the conveyor, the part moves on to the next station on the assembly line. It saves floor space and improves efficiency by eliminating the non-value added steps to move the parts back and forth between the conveyor and a full workstation. This custom workbench can also serve as a shipping station with easy access to task items and supplies. A section of the rollers on the conveyor can be taken out to incorporate a drop-in scale to weigh a package as it goes through the workstation.

The computer station consists of a custom upright post with custom brackets to mount all the accessories that are necessary to work effectively and ergonomically at a computer. The compact design works well in industrial and medical applications where computer access is needed but there is not enough space for a full workstation.

Custom electric height adjustable packaging workbench design that includes features and accessories for efficient workflow and Improved productivity. Four bin rails hold a large number of smaller items needed in the work process while under work surface and overhead storage give quick access to cardboard packaging materials.

CUSTOM WORKSTATIONS

This pneumatic ball transfers workbench is designed to simplify the moving and handling of heavy loads. Its electric adjustable tilting work surface improves user ergonomics and productivity by better positioning a task, reducing operator reach, and promoting proper posture. It includes a height adjustable front lip for different types and sizes of loads.

Custom electric height adjustable workstation located alongside of a conveyor for material handling operations. Integrated section of roller surface tilts quickly when loaded with multiple totes to provide easy access to the contents for further processing. This fulfillment table ensures ergonomic handling of heavy loads while keeping the essential supplies and tools within easy reach.

Custom electric height adjustable work cell consists of two independently controlled frames. The main frame supports cubbies on three sides of the operator and a smaller pedestal holds a receiving bin that accumulates products from the conveyor. This unique design goes way beyond the conventional definition of a workstation. It is a system that enables an associate to fulfill multiple different orders at the same time with maximum efficiency.

CUSTOM WORKSTATIONS

Custom electric height adjustable industrial packing table designed for online fulfillment operation handling multiple brands. Divided work surface and shelving system allow the operator to separate branded packaging materials within one workstation.

This custom jewelry polishing workstation was made for a high-end jewelry retailer to improve worker productivity and well-being. Space was a big concern in this design challenge. The resulting polishing table features a space-saving three-leg design with two custom cutouts. There is no compromise on functionality. * Polishing equipment and emergency button box were provided by the client.

Custom electric height adjustable workstation optimized for medical prep and pack operations. It features stainless steel top, custom wired shelf with transparent lip to minimize dust accumulation, LED ring magnifier, custom small thermal printer shelf, custom box holder compatible with bin rail, pneumatic height adjustable monitor arm, under work surface CPU holder, under work surface storage cubby, and attached footrest.

BOSTONtec

Ergonomic Workstations

BOSTONTEC.COM
INFO@BOSTONTEC.COM
989.496.3500

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