

# Ergonomics & Lean Manufacturing

## HARMONISING Workplace

Lean is increasingly being recognised as a strategic resource for effective change in organisations. Lean thinking, when implemented correctly, requires effective ergonomics. Effective ergonomics is a necessary part of sustainable organisation. Lean analysis helps make potential ergonomics challenges visible so that these issues may be tackled properly, thus helping in harmonising workplace. It would also be proper to assert that ergonomics and lean manufacturing could go together to make sure that their respective goals and aims are achieved.

**K**eeping people and thus ergonomics, at the heart of the lean philosophy helps assure that the company is not creating new wastes by overburdening the workers. Unfortunately, when a company decides to go lean, ergonomics concepts are often not at the forefront of the thought process. This seems surprising, considering that motion study an element of ergonomics, is essential in lean concepts. More importantly, by strategically keeping the worker at the centre of the process, companies can also experience improved quality along with ergonomic and lean benefits.

To fully understand lean manufacturing and ergonomics, one must understand lean and ergonomics as well as the intersection between the two. The Japanese term for what American companies usually categorise as waste is 'muda' and it is defined as "anything other than the minimum amount of equipment, space and worker's time, which are absolutely essential to add value to the product".

The different types of waste include:

- Motion that does not add value
- Floor space
- Manual effort
- Movements to transport material
- Time to rework, repair or scrap.



The presence of all these wastes in a system has a negative impact on lead-time, cost and quality. The waste of unnecessary motion is particularly related to ergonomics. Excess motion consists of bending, twisting, lifting, reaching and walking. These often become health and safety issues and should be dealt with as

soon as they are recognised.

Many practitioners and teachers of lean thinking add another type of waste: the under-utilisation of the 'workers' talent'. Eliminating this waste from the system means encouraging and making constructive use of creativity of the people actually doing the work as well as assuring that workers are adding value to the product rather than doing 'make-work' activities.

### ERGONOMICS PRINCIPLES

Ergonomics principles and guidelines are extremely useful in the prevention of operator fatigue and stress, leading to potential work-related musculoskeletal and neurovascular disorders. Ergonomics is often referred to as a discipline taking into account human factors affecting or influencing manufacturing. It mainly focusses on the human body, its capacity and limits. Thus, it is often considered as a full-scale scientific discipline that tries to understand interactions between humans and other significant elements of a system, usually the working environment. Ergonomics as a profession, aims at optimising well-being and total system performance of human beings working in a particular environment.

### ERGONOMICS AND LEAN MANUFACTURING

Lean manufacturing is a management principle or approach that principally targets the improvement in competitiveness and

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FACT

The term ergonomics is derived from the Greek words *ergon* [work] and *nomos* [natural laws].

profitability of a business. The main concern of lean manufacturing is to eliminate or scrap unnecessary and wasteful behaviour and practices of work personnel. Thus, it can be said that lean manufacturing and ergonomics go hand in hand. The two work disciplines and principles could greatly and undoubtedly complement each other.

Ergonomics involve the design, assessment and evaluation of activities, tasks, workloads or jobs, products, working environments and work systems. For its part, lean manufacturing involves approaches or business strategies that attempt to maximise productivity in the workplace by reducing, if not totally eliminating, unnecessary and unproductive tasks, activities and working behaviours. Experts estimate that improvements brought about by adhering to ergonomics can bring in lean manufacturing results or save production time by as much as 25 per cent to 40 per cent on an average.

There are five specific branches of ergonomics that can specifically bring in desired and productive results when integrated with lean manufacturing. They are:

**Worker selection**

Ergonomics suggest that to achieve a major streamlining initiative or lean manufacturing effort, companies should adopt top-down approach. That means to be able to eliminate and prevent wasteful and unproductive practices and behaviour in the office, they should hire personnel who would apparently be able to contribute to maximised productivity.

**Man-machine allocation**

Allocation in ergonomics and lean manufacturing means the division of work between personnel and machines or manufacturing equipment. To be able to achieve this ergonomics goal, management should carefully plan and assign the use of specific manufacturing machines

to certain personnel. Through this, both workers and equipment are not worn out, thereby, increasing productivity.

**Anthropometry**

Anthropometrics focusses on the human capacity. This branch concentrates and deals with the weight, dimension and strengths of the personnel's physical body. By doing so, production will not be interrupted and smooth pacing of manufacturing is attained. Workers who are physically not strong will be assigned to handle work and equipment that they can surely handle, while stronger workers will be given jobs using machines that fit their physical capacity.

**Biomechanics**

Biomechanics deals with the human body, wherein human movement and its mechanical forces are closely studied. In biology, motions and movements of the human body burn energy. Conserving body energy and allocating them for activities that will benefit production, give a boost to manufacturing.

**Physiology**

Lastly, physiology deals with the anatomy of the human body. Designations and assignments of machines are done by first considering the physical structure of the workers' body. This time, it is not focussed on certain body groups like muscles or energy requirements, but the whole body system, from physical to mental aspects.

**INTEGRATING ERGONOMICS WITH LEAN IMPLEMENTATION**

Ergonomics and lean manufacturing are interrelated disciplines. Companies and firms that aim at maximising productivity should take the initiative to adopt and implement ergonomics and lean manufacturing strategies and processes.

**WORK STATION DESIGN**

Pull production is a basic tenet of lean manufacturing. In a pull environment, downstream activities, such as assembly, signal their needs to upstream activities, such as material handling. The same principles apply to a lean workstation; operators pull parts and access tools when and where they need them on a just-in-time basis. At first glance, lean workstations may appear to be similar to traditional workstations, but they are inherently different. Lean workstations should focus on critical operator issues and concerns such as safety, ergonomics, finding tools quickly etc. A lean workstation puts all the assembly materials required at the operator's fingertips. They are strategically positioned for assemblers' ease.

In addition, a lean workstation must be 'takt time-centered'. Takt time is a common lean manufacturing term that refers to a reference number that is used to match the rate of production to the rate at which customers require finished units. Takt time is determined by dividing the total available production time per shift by the customer demand per shift. It must be comfortable for the operator and should include the tools necessary to complete the current task safely. Workstations can be function independent and lean, but some of the effort is lost if the other workstations, processes and facility layout are not in sync.

**WASTED MOTION**

Eliminating wasted motion is a critical component of any lean manufacturing initiative. Unfortunately, workstations are notorious sources of waste. When muscle strain is coupled with excessive reaches, such as when bending to lift heavy objects or locate tools, then productivity declines further as fatigue mounts during the shift. Excessive walking is another indicator of a sub-optimised workstation except in cases of cellular manufacturing where an operator circulates between adjacent stations. Wasted motion in an assembly workstation can vary with the type of production and the associated volume. In a low-volume, custom-build situation, the typical waste is - having



*Ergonomics helps to sail through stumbling blocks.*

to look for tools, parts and information to complete the job. In high-volume production, the waste is typically related to turns, twists, reaching or walking to get parts. The principles of motion economy reduce waste at the workstation or micro-level. They make repetitive tasks easier, more efficient and effective.

### EVALUATING WORKSTATION

To be truly effective lean tools, we must devote more time and effort up front before specifying a workstation. Till date, most workstations have been designed without taking ergonomics into consideration. When evaluating a workstation, focus should be on specific areas, such as:

- Handling of product or materials
- Tool documentation and parts presentation
- Organisation and storage.

It's especially important to analyse the frequency of reach for parts. The most commonly used parts should always be placed near the operator. Adaptability to changing processes and tasks is also important. The only certainty is the inevitability of change in the products and the processes and tools used to build them. Workstations must not be a barrier to change, but a complement and an aid to change.

Workstations must be easily and affordably adaptable to changing processes and tasks and of course, easily tailored to the physical attributes and work habits of those using them. The ultimate goal of the workstation is to increase productivity of people who use them. It should comply with the principles of lean manufacturing.

### OPERATOR CONCERNS

Observing the operator at work is an important part of the workstation selection process. They know better than anyone as to how products are made and processed. Asking operators a series of questions, such as:

- What are your pains or annoyances?
- How does the workstation fit within the facility environment?
- What happens before and after the product arrives at the workstation?
- What do you want to change about the work area?
- What do you like about it?

These factors affect the workstation

size, shape, accessory choice and placement and whether it should be mobile or stationary. Document different tasks that need to be performed at the workstation and accessories that may be able to provide relief. Use information from the operator to find modular workstations that provide variety in surfaces, configurations or sizes, such as height, depth and width.

### PARTS VS. TOOLS

When designing a lean workstation, engineers must determine whether it's more important for operators to be able to get to parts efficiently or to find tools quickly. The answer depends on numerous factors, for example, the type of product being assembled. For some applications, a successful workstation starts with the tools in a central location where they're going to be used. The rest of the workstation can be designed around that, putting parts where they are needed. In other cases, parts are a more important consideration than tools. They are both needed to get the job done. The ideal workstation allows parts and tools to co-exist peacefully.

### PRINCIPLES OF MOTION ECONOMY

Following are some guidelines for designing a workstation

- Motions of arms should be made in opposite and symmetrical directions and should be made simultaneously.
- Smooth, continuous motions of the hands are preferable to zigzag motions or straight-line motions involving sudden and sharp changes in direction.
- Ballistic movements are faster, easier and more accurate than restricted or controlled movements.
- Rhythm assists smooth and automatic performance. Arrange the work to permit an easy and natural rhythm.
- There should be a definite and fixed place for all tools and materials.
- Tools, materials and controls should be located close to and directly in front of the operator.
- Gravity feed bins and containers should

be used whenever possible.

- Drop deliveries should be used whenever possible.
- Relieve hands for work that can be done more advantageously by a jig, fixture or foot-operated device.
- Pre-position tools and materials.
- Levers, crossbars and hand wheels should be located in such positions that the operator can manipulate them with the least amount of change in body position and with the greatest mechanical advantage.

### Integrating ergonomics with lean

- Fitting the task to the person
- Designing for human capability
- Using the best work methods
- Minimising injuries and their costs
- Improving productivity & quality.

### Outcomes of ergonomics when integrated with lean

- Improved morale
- Reduced absenteeism
- Reduced turnover
- Enhanced corporate culture/climate
- Increased ownership in the processes by the people actually doing the work.

### CREATING A SUSTAINABLE ENVIRONMENT

Process improvement can bring about and sustain positive change, helping staff through the implementation of change by demonstration and example, and by providing the tools they need to work more safely and effectively. Helping workers to be the architects of their own work environment creates an atmosphere of mutual trust and respect. Sustainable work safety is achieved through an ongoing program for corporate culture change such as through the application of lean management principles. The successful implementation of lean thinking and ergonomics includes the redesign of work, standardising work and reduction or elimination of musculoskeletal disorder risk factors.

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