

# Lean Manufacturing Principle & Their Applicability & Benefits in Manufacturing Industries

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**Abstract-** Lean manufacturing, spearheaded by Toyota, has been credited with the main enhancements underway proficiency and item quality since the change from make manufacturing to large scale manufacturing in the mid twentieth century. It addresses a far reaching theory for organizing, activity, control, and the executives of creation frameworks that is accepted to have wide relevance. This paper diagrams significant lean manufacturing principles and talks about their basics and benefits in manufacturing industries.

**Key Words:** Lean manufacturing, Principles, Manufacturing industries.

## 1. Objective

1. To study 9 Principle of Lean manufacturing
2. To study benefits of Lean manufacturing Principle

## 2. The 9 Principles of Lean Manufacturing

### 2.1 Continuous Flow

The supported state of the lean work cell is U shaped. Each sub system is connected with the join planned by measure. With the laborer in inside the U, least improvement is needed to move the work sort or get out start with one workstation then against the accompanying. At long last, one of the objections of the lean work cell is to take out all not notice included improvement along these lines its U shape. Precisely when the specialist has completed the system, he simply pivots and is once again at getting sorted

out one. The work piece might be passed on start with one view included development then onto the accompanying. Regardless, there are times when the work piece or the foundation holding the work piece is unreasonably overwhelming and should be exchanged precisely between workstations. However overwhelming parts might be moved on belt transports, manual push or gravity transports are ideal for moving parts between workstations. Their base adaptable quality makes them simple to benefit and cutoff focuses down time. Additionally, they are certainly not hard to interface start to finish, which makes it simple to move workstations inside a work cell. The turned "corners" of the U shaped work cell can address an issue. As expected dead space, they might go probably as a tinier than typical cutoff region, thusly encouraging a passage to bunch preparing. Or on the other hand possibly, the utilization of a ball roller exchange should uphold part progression through the sides of the U shape.

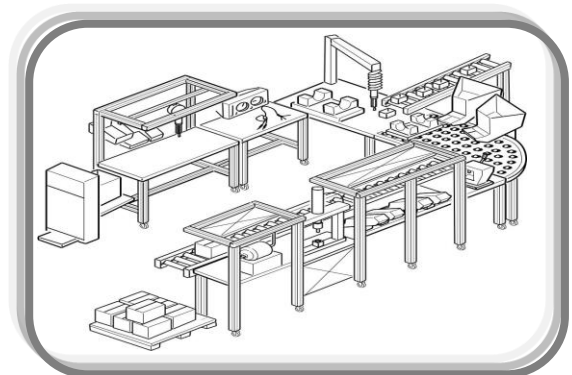


Figure 1: U Type Cell (Continuous Flow)

**a. Continuous Flow Basics:**

1. U shaped cell,
2. Connect sub shapes,
3. Value add to regard incorporate undertaking
4. Machines masterminded by process
5. Parts get in contact as required
6. Counter clockwise flow
7. One-piece flow
8. Non designed work done outside cell by help people

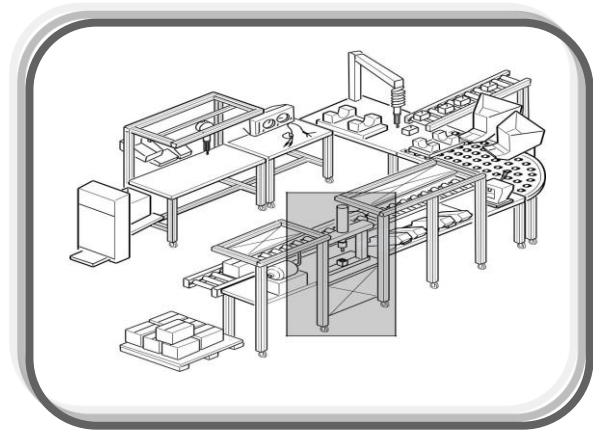
**b. Benefits:**



**Figure 02: Benefits of Continuous flow**

**2.2 Lean Machines/Simplicity**

Since consistent stream, each one in this manner conveying is another objective of lean manufacturing it is essential that every workstation or machine be required to fit inside an immaterial envelope. The immaterial envelope guarantees the completion of abundance level space at the workstation or machine. This is never really increased an indispensable partition from the likelihood of getting parts or sub congregations at the machine. Getting parts broadens work in cycle and results in "group" dealing with, which thusly ruins the reason for lean manufacturing. Moreover, more modest, unimportant size workstations and machines take out superfluous advances taken by the specialist between sub shapes.



**Figure 03: Lean Machine/Simplicity**

At last, huge floor space might be saved by fittingly assessing workstations and machines. However enticing for likeness and normalization, the sending of controlled machine bases or workstations for all philosophy ought to be kept up a vital partition from. Each machine base or workstation ought to be proposed to smooth out social affair sub shapes, which an extraordinary piece of the time will move from one workstation to another. This customization can be master with on a very basic level any fundamental material. To save cash on cost, in any case, and despite limit the normal contemplations identified with discarding firm welded steel structures, inclination ought to be given to material that is reconfigurable and reusable. The conscious properties of eliminated aluminum, shock together frameworks make them ideal for the execution of lean gathering musings. Furthermore in a steady change condition all workstations and work cells should be something besides difficult to change as handle updates are seen. Notwithstanding their pervasive adaptability in association and plant, lightweight aluminum structures are less mentioning to move when assets of activity is head. Casters might be speedily mounted to the T opened profiles to permit progression without the use of fork trucks or other lifting hardware.

**a. Lean Machine Basics:**

1. Continuous flow
2. Save manufacturing plant floor space
3. No abundance creation
4. No additional rack/cabinet space

**b. Benefits:**



**Figure 04: Benefits of Lean Machine/Simplicity**

**2.3 Workplace Organization**

**a. Tool holders**

A smooth, ceaseless stream of finished work pieces is the pin for postponed result of a reasonably outlined out lean work cell. Nothing can direct or stop this stream speedier than the difficulty or diffusing of apparatuses. In this manner, all devices utilized at a workstation ought to have their own specific holder. There ought to be unequivocally an unclear number of holders from that point are devices with the target that the non appearance of a mechanical manufacturing is immediately noticed. Utilizing a purposeful mechanical manufacturing holder structure with a particular holder for each instrument is incredible. On the off chance that holders can without a great deal of stretches out be added to or cut down a workstation this evenhanded adds to the adaptability of the workstation and develops its help in a lean social affair measure. To bind personal time, stronghold gadgets ought to in like way be accessible at any mechanized workstations. These lean manufacturing ought to be out of the position's way until the point that the second that a mix-up happens at the mechanized workstation. Of most over the top favored outlook is instrument holding structures that enable devices to be swung or slid into the work area and effectively got back as far as possible position when never again required.

**b. Information Boards**

Routinely, the prepared transparency of work fundamental data in like way adds to ability in a work cell. Giving the right data at the work environment, for example, get together system, work rules, fix structures, or even creation targets, engages laborers to make the right choices and circle back to them on the spot, obliging personal time a significant part of the time spent pursuing down a clamoring head Similarly with everything in a lean work cell, the data load up ought to be fundamental, simple to reposition, and reusable.

**c. Workplace Organization Basics:**

1. Organize apparatuses with proper device holders & Provide go down apparatuses at programmed stations
3. Insist on adaptable apparatus mounting structures
4. Put the correct data where it's required

**d. Benefits:**

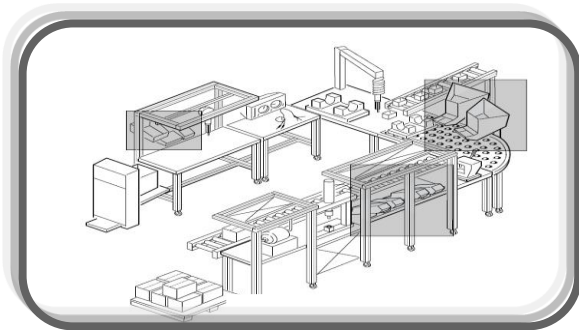


**Figure 05: Benefits Workplace Organization**

**2.4 Parts Presentation**

Ordinarily, in the focal point of the customary work move extra parts will be needed for the work cell. Standard philosophies for resupplying workstations are not productive in a lean work cell. Every specialist should move toward his work with the base number of interferences. Thusly, all parts ought to be given to every workstation from outside the work cell. The use of gravity oversees transports or a holder fits the patched up arrangement of the lean work cell. Parts vaults should stack from behind (outside the functioning space of the work cell) so the laborer might proceed with creation

without interference. Gravity gives the parts to the ace achieve region. Canisters ought to in addition be reconfigurable. The canisters utilize a critical stud to get them position. Containers are stackable and give a definitive in adaptability while reconfiguring the working environment. Dismissing how storehouses are ideal for little parts, different social events require larger parts. These might be passed on in canisters or boxes. Again the parts ought to be given to the work cell without entering the work area. Gravity upholds transports work commendably subsequently. In the occasion that part or compartments should be removed from the cell, an extra gravity support transport might be mounted in the furious heading. In occasions where parts are overwhelming, lift help contraptions are suggested. Overwhelming parts or boxes of parts can be stacked onto a case lifter and raised to the right work stature with electric, pneumatic, or water driven force.



**Figure 06: Parts Presentation**

**a. Parts Presentation Basics:**

1. Supply parts as required
2. Parts stacked from outside the cell
3. Use gravity sustain as the favored strategy
4. FIFO parts introduction

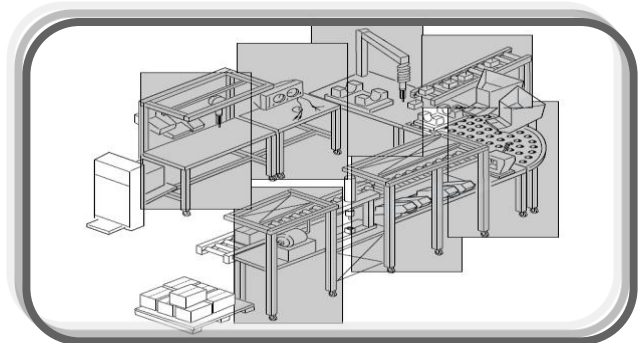
**b. Benefits:**



**Figure 07: Benefits of Parts Presentation**

**2.5 Re configurability**

An appropriately orchestrated lean work cell should be something besides hard to reconfigure. Indeed, the capacity to change the strategy and go from staggering part to wonderful part however fast as conceivable seems to be an out and out need. The speedier the changeover, the less creation time is lost. Fast change foundations are one way this can be ace. With a decent brilliant change mechanical gathering, changeover can be refined very quickly. Distinctive different contraptions might be gotten at the workstation and traded as the circumstance requires. A lean cell should be in a flash reconfigured or even moved to suit get together of something else. If a machine or workstation should be changed, the capacity to move each part of the work cell rapidly winds up being fundamental. Lockable casters on machines or workstations give the pass on capacity basic to speedy and valuable changeover.



**Figure 08: Re configurability**

**a. Re configurability Basics:**

1. Fixtures must be anything but difficult to change
2. Mobility is basic

3. Good part to great part as fast as could be expected under the circumstances

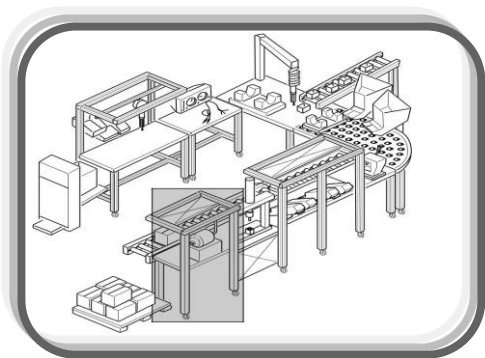
**b. Benefits:**



**Figure 09: Benefits of Re configurability**

**2.6 Quality**

One of the inevitable results of each one along these lines making is decline in quality issues. As each part is made, visual assessment by the laborer can watch that it is sufficiently aggregate. On the off chance that confirmation is needed through gages, they ought to be mounted to the machine or workstation and be sufficiently displaced. Speedy passage of gadgets utilizing star handles or catapulting switches is a need.



**Figure 10: Quality**

There might be time when a quality issue can't be effectively settled. A flawed technique or isolating machine might be the wellspring of the quality issues. By prudence of an imperfect method, the fundamental incorporating framework licenses changes, paying little brain to how glorious, in a base proportion of time. Without a doubt, shock together progression manages a basic issue in smallest time. An isolating machine may comparatively be effectively superseded, especially if vivacious pulls out for all pneumatic or electric lines are fit when the lean cell is

framed. Moreover, no pneumatic or electrical affiliations ought to be open between machines in the lean cell. These would coordinate the changing of the machines inside the cell. When the machine has been disengaged from all force sources, it tends to be effectively shipped whenever mounted on lockable casters. Ease of reconfiguration and changeover butcher any revultion concerning the position or association to try to "manage" with machines or strategies that are "nearly" correct. This alter in context can contribute incredibly to true blue quality age.

**a. Quality Basics:**

1. Visual examination is the essential methods for quality confirmation
2. Test apparatuses and gages must be anything but difficult to supplant or change out
3. Easy reconfiguration supports changes for quality's purpose

**b. Benefits:**

**Quick criticism on quality as specialists examine parts, stage for constant change, dispose of revise zones urge changeover to comprehend "minor" quality issues, more prominent quality affirmation by giving the duty to the constructing agent, fast difference in quality gauges as gathered item or process changes.**

**2.7 Maintainability**

Straight imposition of association is another fundamental of a lean cell. Long down conditions can't go on without certified outcomes in a draw through structure. Precisely when client requests exist the thing should be passed on. A purposeful assistant encasing structure gives a decisive in sensibility. Parts can be displaced or reconfigured surprisingly fast. Fasten together improvement guarantees

machine stands, watchmen, workstations, or parts show gear can be adjusted very quickly. Certainly, even whole machine bases can be revamped in a base proportion of time. The fundamental incorporating framework in like way gives a source to essential segments for all machine bases, watchmen, and workstations. With normalized parts, a base number of instruments are needed to keep up a construction. With a crucial including framework, three or four fundamental hand instruments are adequate to create or fix any construction. Another favored outlook is that essential segments clear out the need for a tremendous heap of extra parts. It is feasible to manage on one size of aluminum profile, maybe a few connectors, and a couple of assistants to make all around that truly matters any design. At long last, no all out work is needed with an aluminum structure. No welding or painting is required. Fixes can be refined in the base proportion of time.

**a. Maintainability Basics:**

1. Ease of administration
2. Manual goes down
3. Put the administrator manual on the machine
4. Standardize however many parts as could be allowed
5. Use normal apparatuses and installations
6. No complete work required on framework parts.
7. Minimum extra parts fundamental

**b. Benefits:**

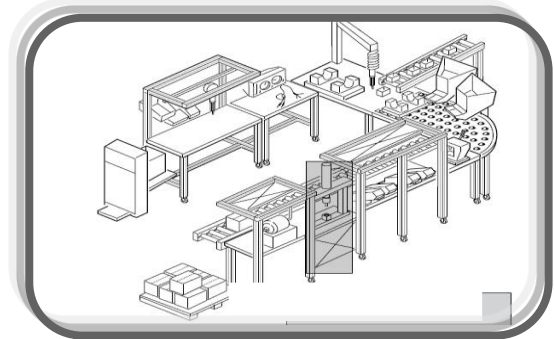


**Figure 11: Benefits Maintainability**

**2.8 Ease of Access**

Utilizing an aluminum outlining framework as the establishment of a lean cell, all urgent work sections can be mounted in sufficiently open regions considering how each surface is a potential mounting surface. Parts holders,

instruments, racks, and foundations would all have the ability to be orchestrated in the ideal district for proficient work. The T opening on the edge framework's surface in like way licenses speedy repositioning of pneumatic or weight driven parts if opportunity space is fundamental. Parts might be added rapidly to any workstation and handily repositioned to shield openness for every laborer. Besides, whole gets or singular sheets can be cleared rapidly with direct hand contraptions, drawing in association experts to perform reinforce surprisingly fast.



**Figure 12: Ease of Access**

**a. Accessibility Basics:**

1. All controls or apparatuses situated considering ergonomics
2. All serviceable parts at back of machine/workstation to execute obstruction of support staff with generation
3. Clearance for all apparatuses for usability
4. All gatekeepers simple to expel with straightforward hand instruments

**b. Benefits:**



**Figure 13: Benefits of Ease of Access**

## 2.9 Ergonomics

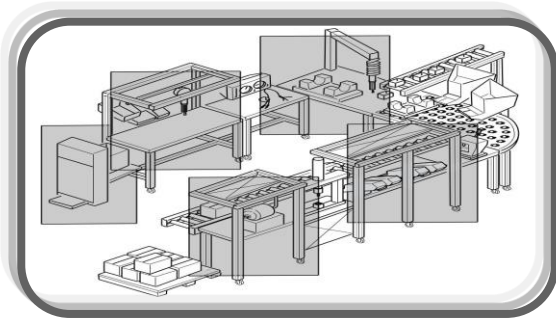


Figure 14: Ergonomics

### a. Height

At long last, the master should be shielded from ergonomic issues. Any fittingly orchestrated lean work cell must, by definition, be ergonomically shaped. Keeping up the work at the ergonomically adjust significance all through the work cell is consistently fundamental. Disregarding how it is occasionally not considered, making courses of action for the standard laborer stature is besides a need. Since standard heights delay from one country to another, the tallness of a machine or workstation should be handily changed in case there is any given that a workstation might be shipped from one country to another.

### b. Lifting

Lift assists gadgets with being viewed as where the enormity of parts or boxes of parts beats lifting measures. For the present situation, pneumatic, weight driven, or electric contraptions might be utilized, yet recall that more straightforward is better in lean gathering cells. With a specific genuine goal to adjust delays in gathering brought about by defective graph, a thing bundle that enables you to test the ergonomics of a work cell before the work cell is developed can be an excellent contraption. Utilization of such a thing bundle permits you to settle ergonomic issues in the course of action figure out instead of on the manufacturing plant floor, giving basic potential theory accounts in both time and cash.

### c. Ergonomics Basics:

1. Position work piece at ideal tallness for specialist
2. Use NIOSH guidelines to decide most extreme lifting loads
3. Position all devices inside the specialist's field of reach
4. Provide lighting adequate to achieve the undertaking

### d. Benefits:



Figure 15: Benefits of Ergonomics

## 3. Conclusion

The current shape of the lean manufacturing principles is unequivocally impacted from one viewpoint by rehearses for association of creation frameworks started by Toyota. One of the significant hardships organizations experience in endeavoring to apply lean isn't information on specific instruments and strategies, maybe absence of exhaustive and reasonable lean information identified with plausible issues inside the organizations by the management and an absence of acknowledgment of lean culture in entire of the association and arranging, which thus cause disappointments in lean execution. Lean Manufacturing is an idea as of now adequately develop that it is conceivable to characterize its construction which is made among others by: theory, standards, practices and devices. Further developed item quality and the related financial advantages in maintainable creation frameworks can be accomplished through lean rules that dispose of vulnerabilities in measures, lessen squanders and non-esteem adding exercises; and coordinated item improvement and manufacturing measures alongside the

interoperability of data frameworks can upgrade the business esteem underway frameworks.

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