

# Review of Lean Manufacturing as a production management technique

## *Implementation of various lean manufacturing strategies for increasing overall equipment effectiveness*

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**Abstract** - This paper explains about a new type of Cell type manufacturing system used by Bosch-Rexroth group. This new production system uses the old lean manufacturing system but incorporates new production methods to cut down the production time and to provide better ergonomics. All the production management systems are compared with new lean manufacturing techniques to see if this strategy can work in today's work environment. Overall equipment effectiveness is calculated for the specific cell type manufacturing system and are compared with ideal cycle time.

**Keywords**—lean, manufacturing, cell, quality, machines, product, time.

### INTRODUCTION TO BOSCH-REXROTH PRODUCTION SYSTEM

Bosch-Rexroth production device adopted BRPS lean production system. Lean production is a method that depends substantially on flexibility and place of business organization, is an incredible start line for organizations trying to take a step towards modern manufacturing methods. Lean techniques also are worthy of research because they eliminate huge capital outlays for committed equipment. Lean manufacturing processes work way differently than that of automated machines. The “much less is better” technique to production results in a massively easy as well as not obstructive to work in such cell. The cells are designed in conjunction with the manufacturer. The purpose is to produce the exact number of cells required and not more than desired. And considering that confined numbers of parts are produced, it could be important to trade methods at some point of the day—to house special parts and to make most use of employees, machines and floor space. The tractability is natural in manual assembly cells is consequently superior to automated meeting. This requirement for max flexibility creates specific demands on the workcell and the machines help in forming such setup. Granted, the lean method isn't the solution for all manufacturing issues. But it does offer an unique solution for assembling more complicated products. The diagram suggests nine primary lean production ideas that must help

an employer compare lean production solutions for manufacturing purposes.

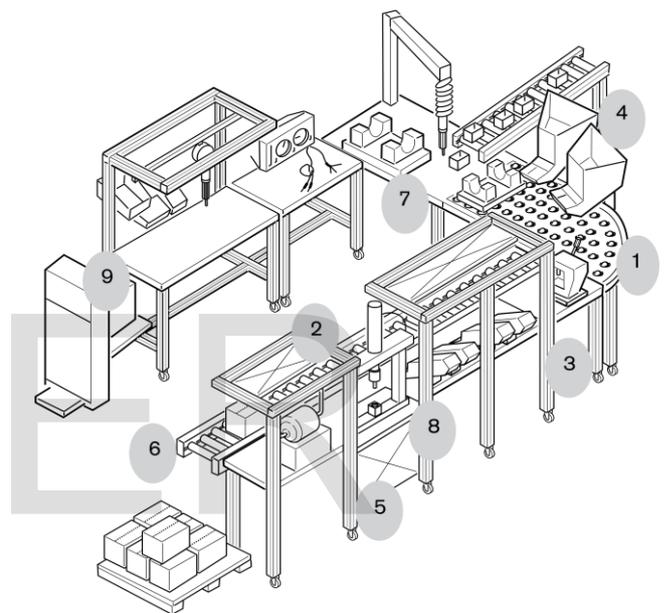


Fig 1. U Shaped Cell for manufacturing

The 9 standards shown inside the diagram are:

1) Uninterrupted process 2) Lean Machines 3) Commanding Block 4) Component Presentation 5) Re-positioning 6) Quality Check 7) Maintainability 8) Accessibility 9) Ergonomics.

1) Uninterrupted process

The desired form of the workcell is U-shaped. Every station is connected to the next consecutive machine. With the employee inside the workcell, minimum motion is needed to change the product or assemble from one part and to move to the next. While the employee has finished the system, he without a doubt turns round and can return at the first step. The workpiece can be carried from one operation to the subsequent. Sometimes the workpieces are above the

desired weight and are not suitable for easy transportation from one end to other. Some products can be easily lifted or given to the workstations through belt conveyors, hoists and cranes are perfect for shifting parts between workstations. Their minimal difficulty makes them clean to move around and reduces down time. In addition, they're easy to attach stop-to-stop systems, which makes it clean to transport workstations within a workcell. The curved "corners" of the in the workcell may create a problem due to which they are rounded off. As an alternative, the usage of a ball curler transfer system is needed to facilitate element movement via the corners of the U-form.

## 2) Lean Machines

Uninterrupted process is significant that each system should be planned according to certain area of workspace. The minimalistic design ensures the removal of excess flat space on the machine. This is done to keep away from the opportunity of storing components or subassemblies at the system. By keeping parts between various subprocesses will lead to difficulty in processing of material., which ultimately defeats the motive of lean manufacturing. Further, smaller, minimum size workstations and machines eliminate needless steps taken by using the employee among subprocesses. Sooner or later, huge floor area can be stored by using some workstations and machines. Regardless of the way that enticing for similarity and institutionalization, the organization of institutionalized framework bases or workstations for all techniques must be stayed away from. Every machine needs to be designed to optimize each process individually, which in maximum cases will range from computing device to instruments. This customization may be completed with simply any structural representation. To decrease the environmental considerations related to removing inflexible welded steel structures, there is a need to use reconfigurable and reusable parts. The particular attributes of expelled aluminum and chromium together make them ideal for the execution of incline assembling models. In addition, in a persistent improvement, all workstations and workcells must be smooth to conform as framework updates are analyzed. Further to their prevalent adaptability in design, light-weight aluminum structures are less entangled to move when re-setup is fundamental. Casters can be immediately introduced to the T-opened profiles to allow development without the utilization of fork trucks or distinctive lifting gear.

## 3) Commanding Block

A spotless, continuous float of finished workpieces is the desired final product of a pleasantly outlined U-Shaped workcell. Nothing can be continuous or hinder this float snappier than the misfortune or scattering of instruments. Thus, all equipment that use a computing device have to have their personal holder. There ought to be exactly as many holders as there are tools so that the absence of a tool is speedy noticed. Using a modular device

holder gadget with a particular holder for each device is good. In the event that holders can easily be conveyed to or detracted from a workstation, this for all intents and purposes adds to the adaptability of the machine and will expand its convenience in an incline producing framework. To abatement downtime, reinforcement devices need to likewise be to be had at any robotized workstations. These apparatuses should be out of the worker's way until a mistake happens at the predefined time. Apparatus moderating frameworks that permit devices to be swung or slid into the stock help for simple stockpiling.

Information cells :- Naturally, the ready availability of labor essential records also provides to performance in a workcell. Providing the proper statistics on the administrative center, inclusive of assembly strategies, paintings instructions, restore processes, or maybe manufacturing goals. Let's employees to make the proper decisions and to find ways to solve the problems, proscribing the time spent finding the manager.

## 4) Component Presentation

At some phase in the normal work move, additional parts could be required for the workcell customary methods of resupplying workstations aren't valuable in an certainly shaped workcell. Each laborer need to move roughly his work with the insignificant assortment of desired values. Therefore, all parts should be outfitted to every path from out of entryways the workcell. Utilizing conveyors or hoists suits the streamlined design of the workcell. Segments holders ought to stack from behind open air the working locale of the workcell so that the representative may safeguard producing without interference. Conveyors transport the components to the worker's achieve area. Pressing holders should likewise be reconfigurable. Despite the fact that pressing holders are perfect for little parts, numerous gatherings require bigger parts. Those can be included boxes or pressing compartments. Again the components should be acquainted with the workcell without getting into the work space. Gravity sustain transports serve this cause pleasantly. in the event that piece or receptacles ought to be disposed of from the cell, an additional transportation devices nourish transport might be snared inside the turn around course. In times where components are huge, hoists may be used. Substantial parts or pressing compartments of parts might be stacked onto a case lifter and raised to the best possible limit with help of fork lifts or chain driven lifters.

## 5) Re-positioning

A very much outlined workcell must be anything but not so difficult to reconfigure. Truth be told, the ability to exchange the framework and cross from right component to legitimately component as quick as achievable is an absolute necessity. The speedier the changeover, the less down time is lost. Short-trade installation are one way this will be finished. With a compatible apparatus, changeover

might be executed in a matter of seconds. Various particular installations might be put away at the machine and swapped in light of the fact that the situation requires. Now and again, because of framework changes or diverse components, an workcell must be quick reconfigured or even moved to suit gathering of a fresh out of the box new item. Inside the event that a part needs to be changed, the capacity to transport every segment of the workcell expedient is to a great degree. Lockable casters on machines or workstations offer the versatility key for quick and effective changeover.

6) Quality Check

One of the results of single type production is a decrease in high-quality issues. As every element is produced, visible inspection via the employee can confirm that it's far efficiently assembled. If verification is needed of gauges, they need to be set up in the place or workstation and be effortlessly changed. Short release of knobs or locking levers is a need. There may be time while a pleasant problem cannot be effortlessly solved. An unsuitable method or malfunctioning machine may be the supply of the exceptional troubles. In the case of a wrong technique, the structural framing system permits adjustments, regardless of how outstanding, in a minimal quantity of time. Over again, bolt-together creation solves a prime problem in minimum time. A malfunctioning device will also be effortlessly changed, mainly if short disconnects for all pneumatic or electric powered lines are provided for when the lean mobile is designed. Further, no pneumatic or electrical connections have to be set between machines inside the lean cell. These changes are taken for converting of the machines within the cell.

7) Maintainability

Simplicity of supplier is the necessity of an sytem. Long down cases can't go on without serious consequences in a draw through machine. While customer request exists, the item should be created. A particular basic confining device manages the cause in viability. Fixtures can be supplanted or reconfigured inside machine. Cell generation ensures framework stands and a certain machine performs operation in given amount of time. Indeed, even entire machine bases might be modified in a base measure of time. The auxiliary encircling contraption also offers a area for basic parts for all machine bases, workers, and workstations. With institutionalized segments, a negligible number of parts is required to keep a structure. With a basic confining instrument, three or four straightforward hand apparatuses are adequate to build or repair any part.

8) By utilizing an aluminum outline it is staggeringly spotless to mount the greater part of the apparatus on it. Part containers, machines and apparatuses might be put in the best possible range for green spots. The T-opening outfitted is mostly pneumatic or pressure driven fueled so it might be situated without trouble. Segments might be acquainted

quick with any workstation and found easily for short use by utilizing the worker to the fullest.

9) Ergonomics

Any properly designed lean workcell need to, by means of definition, be ergonomically designed. Making the workcell by taking the height of the worker into consideration is equally important. Although it is frequently now not taken into consideration, designing for the common employee height is also a need. Heights of workers change from country to country and hence the workccell needs to designed carefully. If there's any hazard then the workcell can be shipped from workplace to the manufacturer.

COMPARISON OF LEAN MANUFACTURING (U CELL TYPE) WITH OTHER PRODUCTION MANAGEMENT TECHNIQUES.

	JIT	CM	TPM	Lean
Setup time reduction	✓		✓	✓
Reduction in lead time				
Inventory reduction	✓			
Preventive maintenance			✓	✓
Schedule flexibility			✓	
Layout (cellular)		✓	✓	✓
Pull system, kanban			✓	✓
Quality Management				✓
AMT (Computer based tech.)				

Table 2. Comparison between various production management techniques

JIT: Just in time, CM: Cellular manufacturing, TPM: Total Productive Maintenance.

The comparison between some production management techniques clearly show that lean production has clear advantage over other management techniques. Lean production provides quality management which is not provided in any other method.

OVERALL EQUIPMENT EFFECTIVENESS OF LEAN MANUFACTURING TECHNIQUES.

Overall equipment effectiveness (OEE) is a term used to define how commendable a manufacturing operation is utilized. The results are stated in a basic form which allows assessment between manufacturing elements in different industries. It is not however a complete way and is

best used to identify scope for process routine improvement, and how to get the fastest results.  
Calculation of Overall equipment effectiveness for U Cell type manufacturing techniques.

Example: Components manufactured with Cell type lean manufacturing.

ITEM	PARAMETERS
Shift Period	10 hours (600 minutes)
Breaks	(3) 15 minutes and (1) 30 minutes
Down Time	60 minutes
Ideal Cycle Time	1.0 seconds
Total Pieces	23,550 workpieces
Rejected Pieces	508 workpieces

Table. 3 Example of Overall equipment effectiveness

### 1) Desired Manufacturing Time

Any breaks taken during the shifts are excluded.

**Formula:** Shift Length – Breaks

**Eg :-** 600 minutes – 75 minutes = **525 minutes**

### 2) Run Time

The actual amount of time for which the cells/machines are running needs to be calculated

**Formula:** Desired Manufacturing Time – Down Time

**Eg :-** 420 minutes – 47 minutes = **373 minutes**

### 3) Acceptable workpieces

**Formula:** Total Pieces – Rejected Pieces

**Eg :-**

23,550 workpieces – 508 workpieces = **23042 workpieces**

### 4) Obtainability

Obtainability is the first of the three OEE factors to be calculated. It is the percentage of time for which the machines are available for running.

**Formula:** Run Time / Desired Manufacturing Time

**Eg :-** 373 minutes / 420 minutes = **0.8857 (88.57%)**

### 5) Performance

Performance is the second of the three OEE factors to be calculated. It constitutes for which the process is running slower than its theoretical top speed (both Short Stops and Slow Cycles).

**Formula:** (Ideal Cycle Time × Total Count) / Run Time

**Eg :-** (1.0 seconds × 23,550 workpiece) / (465 minutes × 60 seconds) = **0.8369 (83.69%)**

### 6) Quality

Quality is the third of the three OEE factors to be calculated. It accounts for manufactured parts that do not meet quality standards.

**Formula:** Good Count / Total Count

**Example:**

(23550-508) / 23550 workpieces = **0.9699 (96.99%)**

### 7) OEE

Finally, OEE is calculated by multiplying the three OEE factors.

**Formula:** Obtainability × Performance × Quality

**Example:** 0.8857 × 0.8369 × 0.9699 = **0.7189 (71.89%)**

The OEE for this shift is **71.89%**.

So the Overall equipment effectiveness for U Cell type manufacturing techniques is 71.89%.

## CONCLUSION

Lean manufacturing provides a different approach for maximizing the output of a given process. It provides a new way to efficiently manufacture products and a sustainable way to produce goods. Lean manufacturing Cell aims at providing an ergonomic setup to manufacture goods and also comfortable environment for the employee.

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