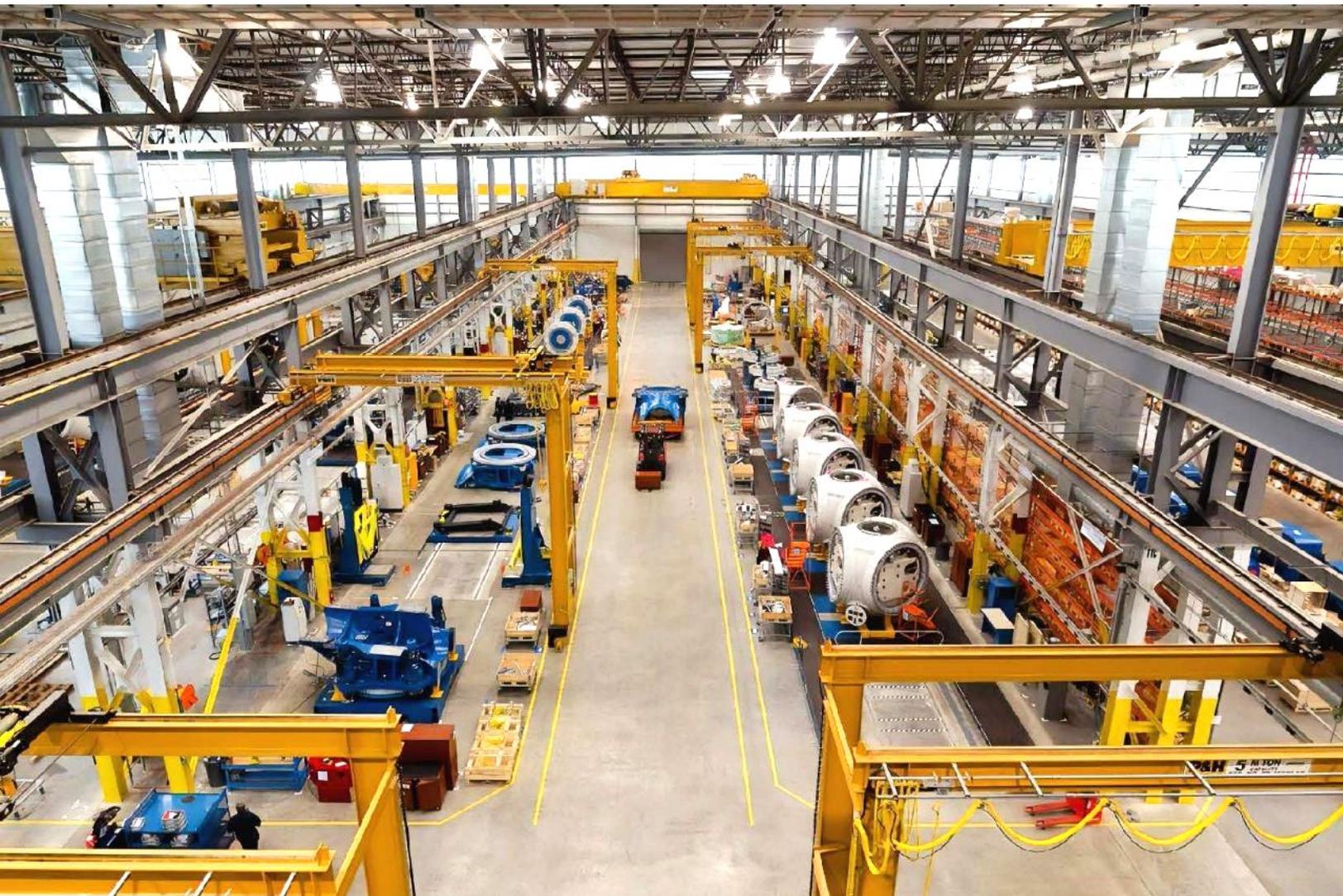


Air Casters & Lean Manufacturing

How air casters help optimize lean manufacturing processes and operate more efficiently and more productively, at lower cost.



Moving assembly lines into leaner layouts can increase throughput and efficiency. But that requires an equally efficient material handling system.

Lean manufacturing is a production philosophy that emphasizes efficiency: operating at maximal quality output with minimal waste. It's about tailoring every aspect of the manufacturing process – workflow, plant layout, distribution and usage of people, and more – to ensure the most effective production possible while still delivering a high-quality end product.

It's an approach that can generate real gains. For example, after implementing lean processes, one manufacturer of commercial air conditioners and heat pumps reduced hours-per-unit from 9.28 to 5.19 (a 44% improvement) and reduced floorspace by 50%. An auto parts manufacturer was similarly able to cut 42 feet from its assembly line, reducing operator travel by 40%.ⁱ

That's because traditional plant layouts tend to be more erratic, involving more work-in-process inventory and longer lead times. As a result, it can take 30% to 50% more floor space just to accommodate increased inventory storage and material handling routes and equipment.ⁱⁱ

And where more space is required, so too is more time: it inevitably takes longer for materials, workers, and product to move through production, resulting in otherwise unnecessary motion and transportation.

In fact, this is the crux of the difficulty inherent in traditional manufacturing systems: one form of waste begets the next form, and inefficiency stacks.

Because lean layouts move machines closer together in a smarter workflow, the manufacturing process

ultimately requires less in-process inventory, less material handling, less transportation/motion, and less physical space. "Space between machines is minimal to prevent inventory from building up, as well as to reduce motion and conveyance," says Sammy Obara, president of Honsha Associates, a lean manufacturing consultancy group.ⁱⁱⁱ "A key difference between traditional and lean plant layout is that in a lean environment, there is very little room for waste and when there is waste, it becomes visible."

"Plant floor design is the key to an efficient production environment."

Assembly Magazine

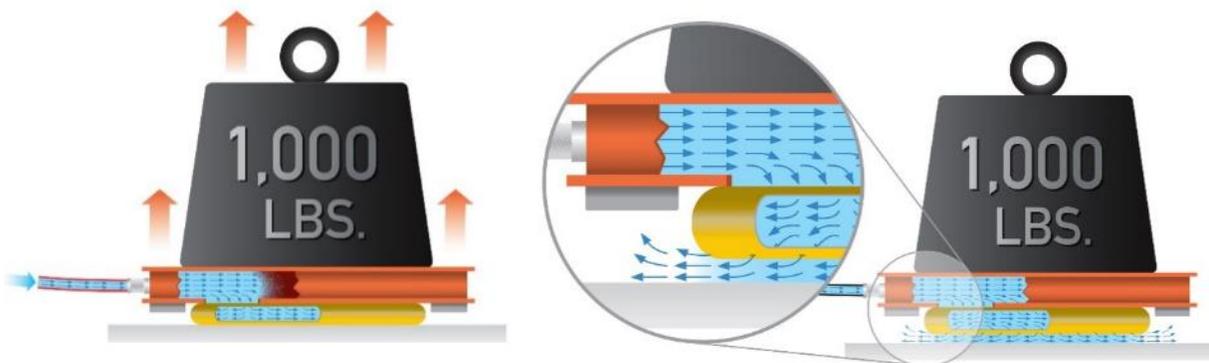
However, a lean-inspired floor layout goes further than just squeezing machines closer together. Everything should be able to flow through the line as efficiently and quickly as possible – without sacrificing quality. It helps if machinery is versatile and can be repositioned or replaced quickly and easily. "Always keep in mind that flexibility is paramount," writes *Industry Week*.^{iv} "There may be some re-engineering or re-sequencing of the part and sub-assembly timing."^v

But if lean manufacturing relies on agility and adaptability, manufacturers can easily run into problems. Re-engineering, re-sequencing, and re-positioning production lines are nontrivial challenges because most traditional material handling systems – forklifts, cranes, and even wheeled casters – force inefficiency into the floor layout. They require more space, more labor, and more time to operate, while creating more risk.

This is where air casters fit; the way they work aligns seamlessly with the lean manufacturing paradigm. This paper will detail how.

How do air casters work?

Air casters float on a thin film of air, enabling nearly frictionless maneuverability in any direction such that a single operator exerting 5 to 25 lbs. of force can easily move and precisely position a 5,000 lb. load.



1

Air caster systems use compressed air to inflate an air caster bag beneath the load being moved (the yellow object in the illustration above). Note that the air caster fits entirely within the footprint of the load. As the bag inflates, it lifts the load up slightly (no more than a few inches).

Once the bag reaches full capacity and offsets the load's weight, air evenly leaks between the bag and the floor until a thin (0.003" to 0.005" thickness), nearly frictionless film of air forms.

2

The load then literally floats atop this layer of air. From there, the load – much like a puck on an air hockey table – can be maneuvered in any direction with relative ease, thanks to a friction coefficient of around 1%.

The total floor loading of air casters falls around 25 psi; the floor loading of wheeled casters, by contrast, can equal 2,000 to 5,000 psi.

Standard plant air above 90 psi is sufficient in most cases.

3

With a friction coefficient around 1%, even a single operator can safely move loads weighing thousands of pounds on a variety of surfaces.

Operators require minimal training and no certification; they simply attach an air hose and push.

In general, air casters require only 1/10 of the force required to move wheeled casters.

Air casters add versatility and eliminate waste throughout the manufacturing process.

Air casters can easily float production line assemblies, components, raw materials, or whatever else is needed. Since air casters don't require any permanent in-floor fixtures, travel paths are changed as frequently as needed.

Perhaps you need to remove a unit from the production line for repairs or to wait for a part? Or need to change out equipment as part of a normal process flow? Simply float it away without slowing down production. The result is the ability to move anything within the manufacturing facility – up to and including re-configuring the production line itself – quickly and simply, with minimal effort. The sheer flexibility and extremely low overhead of air casters can make the changeover of heavy equipment very fast and very safe.¹

But the real value air casters present is their ability to help manufacturing operations reduce waste. "Lean production is aimed at the elimination of waste in every area of production," says Dr. David Cochran, director of the Production System Design Laboratory at Massachusetts Institute of Technology.^{vi}

In general, because air casters demand less labor, less time, and less space to operate than virtually any other material handling system, they represent the fastest path to efficiency and economy in a production plant.

Specific characteristics of air casters can be associated with a reduction in various forms of waste (*see chart below*). This paper will detail these forms of waste – and how to ameliorate them – on the following pages.

| Air caster features and the manufacturing wastes they remedy | | | | | | | |
|--|---------------------------|-----------------------|-------------------------|------------------------|--------------|---------------------|----------------------|
| | Omni-directional Movement | Fits within Footprint | Single-Person Operation | Low Vertical Clearance | Easy to Push | Relatively Low Cost | Variable Path Travel |
| Wasted Time | | | ✓ | | ✓ | | ✓ |
| Wasted Space | ✓ | ✓ | | ✓ | | | ✓ |
| Wasted Labor | | | ✓ | | ✓ | | ✓ |
| Wasted Motion | ✓ | | ✓ | ✓ | ✓ | | |
| Wasted Transportation | ✓ | ✓ | | ✓ | ✓ | | ✓ |
| Wasted Money | | | ✓ | | ✓ | ✓ | |

¹ For example, air casters can facilitate use of the SMED (Single-Minute Exchange of Dies) system for reducing changeover times.

1

Recover wasted space

Air casters optimize space efficiency by fitting within the footprint of the load and moving omnidirectionally, thus fitting into tighter spaces.

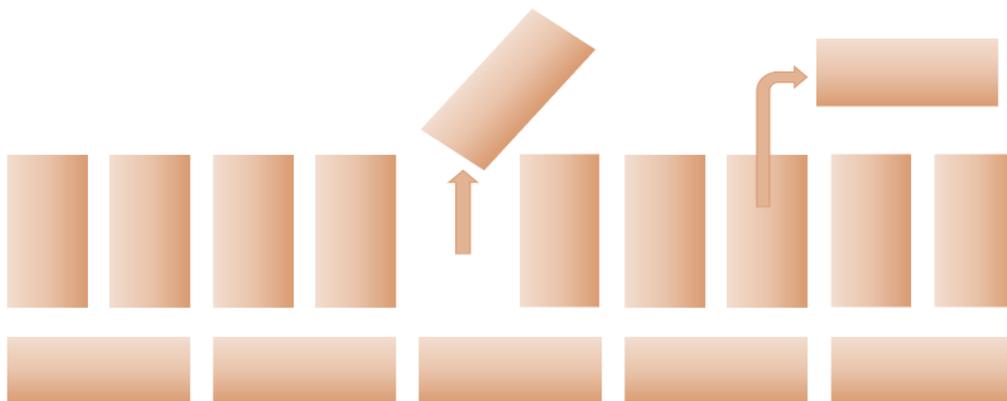
Air casters require less clearance than almost any other material handling system, so machines can be positioned more closely.

Lean is less about the production machines themselves than in how they are arrayed. "Instead of worrying about the fastest, biggest or best tool, you should focus on the spacing between machines on your plant floor and how they're linked together," says Jamie Flinchbaugh, a cofounder of the Lean Learning Center, a coaching and consultancy group. "Focus on the relationship between the machines. Make sure the equipment fits the flow and fits the relationship between other machines in the manufacturing system."^{vii}

In fact, repositioning equipment is often all that's needed to reduce floor space. That allows manufacturers to minimize movement and travel, and operations can potentially fit more production into smaller spaces.

Thus, pace can be allocated based on workflow and functionality rather than logistical concerns around moving machines.

Forklifts, for example, require an enormous amount of clearance in all directions, so production equipment has to be spaced farther out. Even the smaller and more maneuverable forklifts require 8' aisles; larger models could require aisles as wide as 14' or more. They also require significant space at intersections to account for a wide turning radius. Air casters eliminate that clearance requirement, allowing machines to be positioned more closely and maximizing efficiency. That's because air casters fit within the footprint of the object and move omnidirectionally. As a result, air casters can help reduce the total footprint of the working area. Simultaneously, moving machines closer together reduces operational movements (see the next page), which itself can increase productivity.



Air casters allow production lines to work in smaller spaces, while machines can be easily moved in/out or around at need.

2

Save wasted motion & transportation

Air casters minimize both effort and distance traveled through their compact, easy use.

If machines are spaced out further than they need to be, or arranged in a poor workflow, it forces operators to move materials, product, and machinery further distances and/or more frequently than would otherwise be necessary.

“A lean-based approach works on minimizing the distances traveled for material in the facility,” Swapnil Yeole, lean sales engineer at manufacturing supply firm Lean Factory America, told *Assembly Magazine*.^{viii}

For example, inventory of raw materials should be kept as close as possible to the machinery using it. Then, the next machine in the production line should be as close as possible to the initial machine. Shortening these distances and arranging machines in an efficient flow is the entire point of lean.

Traffic – including that of personnel, materials, equipment, and product – also needs to be routed effectively such that everything is easily accessible and mobile.

Wasteful plant design not only leads to needless transportation, it can also trigger other wastes: unnecessary waiting, motion, and overhead & energy costs.

But few manufacturing floors are laid out in this ideal way, and not only does. It also mandates more labor in the form of lift drivers, increases wear-and-tear on equipment, and leads to excess physical motion (lifting, reaching, bending, twisting) that can cause ergonomic strain.

And at the end of the day, excess motion and transportation always translates into higher costs, increased risk, and more waste.

Air casters close these gaps: they keep everything closer, require fewer operators, and work more quickly. This all adds up to less motion and movement.

By recovering wasted space, air casters instantly reduce the amount of distance anything has to travel. Just as waste can stack, so can efficiencies. But air casters are also far simpler to operate than most material handling systems. Because they’re easier to load and use – as mentioned above, even just one person can usually move a multi-ton load safely – they require less motion overall. Even better, they reduce risks associated with ergonomic strain during moves.

3

Minimize wasted time and capacity

Air casters offer fast and easy setup and operation: they simply slip underneath the load to be moved, pick it up, and move it at a push.

People resources and capacity can be wasted just as easily as any other aspect of manufacturing operations.

Bottlenecks, whether resulting from people spending more time than necessary on certain tasks or processes being inefficiently executed, reduce overall productivity and lead to under-utilization of both people resources and production capacity. As with other forms of inefficiency, this kind of waste can have knock-on effects. And as with other forms of waste, all of this has a price tag, including direct labor costs as well as additional overhead costs.

Air casters can speed up bottlenecked processes, and their flexibility means they can be used adaptively, in all kinds of situations, at need. As a result, they directly remediate labor and capacity waste in order to enable higher throughput.

Air casters require only a minimal number of workers – potentially as few as one.

To the extent that a material handling system requires special training and certifications for operators, it limits the availability of that tool to help move loads if the driver is tied up elsewhere. Air casters, however, do not require certified operators and training is minimal (less than 30 minutes). Similarly, the extent of labor required to make a move is greatly reduced. That improves utilization, increases productivity and efficiency, and makes the move system more cost-effective overall.

Air casters also reduce the amount of time start-to-finish required to make moves, from setup to final placement.

Air casters also minimize disruption to production by reducing on-site activity related to moving machines and loads. This is especially true if the manufacturer uses [embedded air casters](#), or air casters pre-installed into their production machinery.

But even without an embedded solution, it's typically quite simple to slide the air caster assembly under the machine, attach an air hose, and just push. Most moves can be completed in minutes, minimizing the productivity cost from workers being unable to focus on core tasks. Only conveyor systems and rails are better suited to moving objects at speed. Cranes, and to a lesser extent forklifts, tend to require lengthier setup and operation times.

4

Prevent future waste

Air casters make it easy to re-configure repeatedly over time as inefficiency creeps back into operations over time.

Because air casters are such a lightweight system of moving even very heavy objects, they can be deployed easily over and over.

Setting up a lean manufacturing floor plan can be exceedingly complex. “A particularly challenging situation is one in which there are many hundreds of products with little commonality in process routings,” Don Penkala, president of Granite Bay Global, told *Assembly Magazine*. “Lean principles can still apply, but it takes some planning to figure out how to segment products into the appropriate families.”^{ix}

This raises the possibility that the first attempt at a lean layout may not work, and the facility might need to start over. If the operation used a cumbersome material handling system to move everything, the re-configuration could represent a huge expense and delay.

Indeed, most layouts are not evergreen. Things change! Operations grow and shrink. The market shifts. New products are developed, old ones are retired. Organizations move facilities. As one bottleneck is eliminated, another will reveal itself. In other words, as needs evolve but layouts remain unchanged, operations become naturally less efficient, and opportunity costs mount unless the manufacturing facility has a material handling system that can enable regular production sequencing changes.

Air casters can be used repeatedly with little expense. Simple to deploy, they are long-lasting (with a lifespan measured in decades) and require minimal maintenance. They are also unobtrusive; when not in use, they can be tucked into a corner. Altogether, the low lifetime cost of ownership means ROI improves the more they are used over time.

In fact, ongoing improvements should be part of any lean system.

“You should look for ways that waste has crept back into your line,” says Drew Locher, managing director of Change Management Associates.^x “As a rule of thumb, if demand has changed—up or down in any substantial way—then you should carefully examine your line layout. It’s also important to do this if you’ve made any product design changes.”

Anything that impedes the need to adapt will erode the benefits to be gained from turning to lean in the first place. Thus, the system used to change layouts must be repeatable without undue disruption. Thankfully, with the ability to reconfigure and adapt the manufacturing system at any time, the organization can save not just space, motion, transportation, time, and labor – it can preserve that efficiency indefinitely. All that is required is a material handling system that can flow as seamlessly as the manufacturing system itself.



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