HMMA: HYUNDAI MOTO

A forgotten link in the supply chain is the time a part or commodity spends at a plant site until it gets assembled into a vehicle.

by John Kalson

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Hyundai began its journey into the automotive manufacturing business in the U.S. only a few short years ago. Since then, we have put together a local and international supply base, built a plant, and hired more than 2,000 people. Launched just over two years ago, our plant has manufactured more than 430,000 quality vehicles.

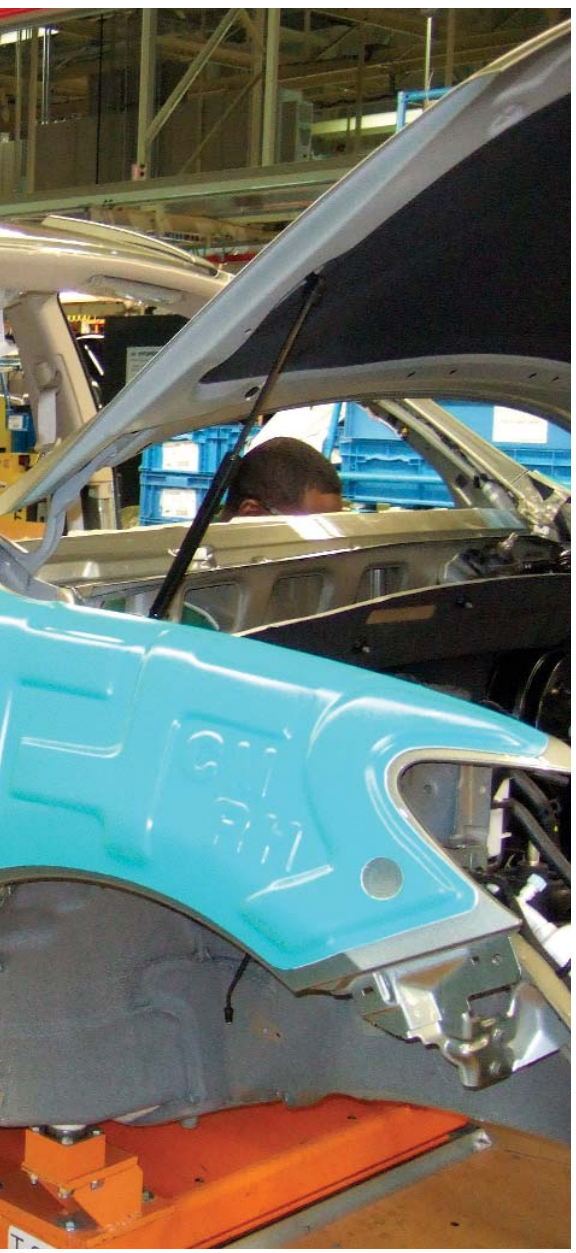
The concepts of supply chain management are vast and all encompassing: strategic management, total quality management, manufac-

HMMA

Workers inspect the Santa Fe on the Hyundai Motor Manufacturing Alabama line.

THE FORGOTTEN LINK

turing resource planning, capacity management, procurement management—the list goes on. There are many different names for the activities performed in this immense scheme, but all are equally important links in the chain: sales forecasting, purchasing and procurement, logistics, and production planning. A final link I would like to focus on sometimes gets lost when we think of the supply chain but is still a critical link. It may be overlooked during the initial logistic planning and sourcing decisions. The link I am speaking about is the time a part or commodity spends at a plant site until it gets assembled into a vehicle.



Some parts go through many transformations and movements after they are delivered, some very few; however, in today's world, synchronization between parts, technology, and humans must be considered at every stage of the delivery, manufacturing, and assembly process.

This link is just as important as any other in the chain. Just as with a delayed shipment, inefficiency, waste, and poor quality will become very costly, very quickly.

Plant Overview

Hyundai Motor Manufacturing Alabama (HMMA) has had the distinct advantage of the opportunity to build on a green field site in Alabama. All of the best concepts throughout the industry were combined to fashion our plant and processes. HMMA was not built all under one roof but uses the campus concept for several reasons—primarily increased outside linear footage and thus better opportunity for more dock doors, making it easier to unload parts. Delivering material to the point of use goes hand in hand with just-in-time and just-in-sequence deliveries. HMMA's approximately 130 delivery doors eliminate the need for a massive warehouse onsite and under precious production-floor roofing. Many small staging areas are close to the assembly destination. One trailer arrives at the facility every 60 seconds, so the availability of useful docks is of the utmost necessity.

Automated Delivery Unload

As we become more advanced and begin to use more and more modules in the assembly process, automated unloading of commodities from trailers is becoming more prevalent. HMMA currently uses several automated unloading processes, including cockpit module unloading, subframe unloading, seat unloading, and front-end module unloading—all just-in-time and just-in-sequence components.

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At HMMA the sequencing signal goes out to the supply base two to four hours before that commodity is required line-side. The synchronization between delivery, unloading, and reloading of empty pallets is like a symphony with rhythm and timing that must be strictly adhered to. HMMA uses a small buffering system between its paint and final assembly departments. At this point in the process, the supply base of the in-sequence components must set in motion the elements for the final building and shipment because the sequence is now fixed.

With automated unloading, the trailers are now integral parts of the production process—an extension of the in-house equipment—and upkeep and maintenance must be strictly adhered to. Like any other piece of equipment, they may have electrical and pneumatic components that need to be properly maintained. There could be nothing worse than the line being down waiting for the parts to get off the trailer at the dock door. With technology comes risk, which can be minimized to enhance overall performance with proper planning.

Racking Concepts

HMMA works closely with its supply base on rack design and building. Rack design has typically been studied for density, durability, and operator use relative to ergonomics. In today's complex robotic world, many racks are now becoming precise holding and positioning fixtures for automated loading and unloading. HMMA uses this concept throughout the facility. Based on the application and the system, some racks need to be more dimensionally accurate than others. Concepts of automated rack unloading vary from mechanical pick-and-place devices to complex vision systems attached to seven-axis robots.

Even the environment around the rack can have an impact on the functionality of the system in which that rack might be used. For instance, if a vision system is used to locate and help pick parts in an automated unloading process, the location of the part in the rack can have a bit of variability, but the rack's holding features must be functional and not compromised. All the locating bars and holding fingers must be properly maintained and working. All a vision system can do is check for distinct features and determine where in space that feature is and where the pick-up points or locating areas should be. Unlike an operator, it only looks at what it is taught to look at. Another area of concern with utilizing vision systems is the amount of light/dark contrast prevalent at the point of use. There is a big difference in picking a part on the second shift at night and picking that same part during the day. Having a dock door open and the light diffusion characteristics change could throw off the entire locating scheme.

If an automated rack is to be incorporated into the unloading process, engineers need to keep a basic principle in mind during the rack concept and design phase: it is a lot easier for a robot to pick from top down versus side to side or vertically. Gravity can do a lot of the work, and the opportunity for slippage can be definitely reduced. Bottom-up loading works very well when various components must be placed together, relying on gravity to nest parts together.

AS/RS Systems

Some parts, after they are unloaded and before they are taken to a point of use, might be placed in an AS/RS (Automated Storage and Retrieval System). HMMA uses many different AS/RS systems—some entirely internal to our processes, some external. The AS/RS systems provide a small buffer zone for just-in-time and just-in-sequence deliveries and are used as starting points for many automated processes. Examples of this are evident in our stamping, engine, and final assembly plants.

Our AS/RS systems are tied in with in-plant Manufacturing Execution Systems for internal sequencing and scheduling. Components placed in these storage systems are called out automatically based on the build sequence of the vehicles.

HMMA uses an offsite consolidation company to handle overseas shipments and modest sequencing. This helps reduce the need for excess inventory on the plant floor, where work can be completed in a controlled environment. These parts are delivered line-side with local delivery vehicles.

Module Assembly

As the migration to modular assembly becomes more prevalent within our industry, a whole new set of circumstances and requirements are now thrust upon the manufacturers of these components. The rules have changed. It is of the utmost importance that the right piece is in the right place at the right time and at the right quality level. A major modular assembly HMMA receives is the cockpit, put in both the Sonata and Santa Fe models. The supplier must ensure that this complex component is built to the correct specification, following the vehicle's build criteria (correct dash panel, correct audio system, and correct options). Our supplier must ensure that the complex quality requirements (color match, electrical continuity and conformity, fit, and function) and sequence and delivery criteria are met.

Technology at Work

I'd like to walk you through the process using the example of our cockpit module.

- The signal goes out to Mobis, our cockpit supplier, approximately two hours before that component is due line-side.
- Mobis builds and loads the correct parts onto a trailer that is delivered to HMMA.
- The trailer backs into an automated unloading dock, and the truck driver makes the proper facility hookups.
- The truck driver hits the button to unload the cockpits onto a feed conveyor.
- The conveyor delivers the cockpits on individual pallets to a robot unload station.
- A vision system takes a few pictures of the locating pins on the cockpit and determines its location in space.
- The robot picks up the cockpit and carries it to a vehicle moving down the assembly line.
- The robot tracks the vehicle, takes a few pictures of its mating components, and determines its exact location.
- The robot places the cockpit in the vehicle and exits the vehicle.
- The pallet makes its way back to the loading dock to be loaded back onto the trailer.
- The trailer heads back to Mobis, where the cycle begins again.

This process happens in less than a minute each minute of every production hour, hence my comparison to a symphony.

Technology

HMMA has some of the best technology in the industry because it was easy to install the best at the green field site. Some of the technologies used include

- vision systems for part picking and locating;
- automated guided vehicles in various areas;
- smart cranes;
- robotic press unloads;
- electrified monorail part delivery system;
- pedestal sealing;
- turnstile framing system (which can accommodate up to four models);
- rotary dip e-coat system;
- 100 percent robotic paint application;
- vision systems for sealing applications;
- automated trailer unloading; and
- automated subassembly insertion (cockpits/seats/etc.).

My philosophy is that any company can buy technology, but it's the employees' hearts and souls—not technology alone—that make a company great.

Predictive Productivity

Accurate sales forecasts and stable production are essential to achieving optimum performance, enabling all parties to allocate resources effectively. With the lead times required for components and the investment savings achievable by not overbuilding facilities, stability ensures a manufacturing plant operates at peak efficiency.

Quality

Every part a supplier puts into a rack, basket, or box is a part the OEMs intend to put on a vehicle. Just-in-time and just-in-sequence concepts make this even more important than ever. Without a large inventory for misses and quality defects, a bad part translates into a repair—the part will not be kept in inventory until it is fixed—which may potentially create additional repairs and problems during the fix, creating a never-ending spiral.

I wonder how many of the employees in a manufacturing role at a Tier One or Two supplier actually know where a part goes on a vehicle and what function it serves. I have always thought this type of education is very inexpensive and provides a bit of buy-in from the people actually making the parts. I don't believe people make mistakes intentionally but rather from lack of knowledge. If they know what they are making and what it is used for, I can just about guarantee the defect rates will go down.

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People

The managerial culture and employees go hand-in-hand all the way through the supply chain. How we manage, motivate, and cultivate people has a tremendous impact on the organizational chain and bottom line.

When we set out to form the HMMA workforce, we wondered how to turn people who had never built a car into people who could turn out hundreds per day. It was an opportunity to teach people with the right attitude the correct methods. Short-order servers, eager to learn, became some of the best car makers in the business. I am proud of our workforce at HMMA.

Conclusion

The part makers are now an extension of the traditional assembly plant, with parts, processes, and people synchronized as never before. I have attempted to follow a part through our assembly process to show that this final link in the supply chain requires a lot of planning, implemention of plans, and execution. ■

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