About the Author

Michael McClellan has over 30 years of experience serving and managing manufacturing enterprises. He has held a number of positions in general management, marketing and engineering, including President and CEO for a multi-division equipment systems supplier. In 1984 he and a group of associates founded Integrated Production Systems, a company that pioneered the use of computer systems to manage and track production events on the plant floor. His first book, *Applying Manufacturing Execution Systems*, defines manufacturing execution systems and explains the reasoning and history behind them. He is a frequent speaker at companies and manufacturing conferences, has presented a number of papers on plant information systems, and holds one patent. He has recently completed a new book, *Collaborative Manufacturing: Using Real-time Information to Support the Supply Chain*.

He currently lives in Washington state and is President of Collaboration Synergies Inc., an advisory company providing consulting services in the area of collaborative manufacturing system development and implementation, plant floor information systems and manufacturing execution systems.
Automotive Industry Collaboration

The automotive industry is a very large and complex global industry made up of the largest multinational corporations with a range of products that includes automobiles, trucks, and mass transit busses. The top-level companies include General Motors Corporation, Ford Motor Company, Toyota, Nisson, Daimler-Chrysler, Volkswagen, Volvo, Honda, Kia and others. These companies are usually referred to as original equipment makers (OEMs). The multi-tiered supply chain is made up of very large companies that may or may not be global in their reach. First level vendors are referred to as tier-one suppliers and their suppliers as tier-two suppliers and so on through the hierarchy. Some suppliers serve only one OEM while others serve a variety of customers. Although supplier relationships are not permanent they do not change at a rapid pace. Investment in facilities and production capacity is high and margins are always thin and based on high volume. The original equipment customer is only one side of the market with aftermarket replacement part sales that can continue for many years.

The industry is in a constant state of change to react to a variety of issues ranging from product design to meet the changing demands of the market, to globalization of production facilities and political swings in the many countries in which they operate. This is a multi-tiered industry with a very broad supply chain network of production material and production equipment suppliers.

Product cycle times are generally considered long term with some models lasting years. Development periods can be lengthy taking as long as 36 months or more from approval of a design to the time production begins and the car is available to the market. The product lifecycle is affected in the short term with frequent annual changes to the product and the production facilities.

The industry has been in a multi-year transition, moving from very vertically integrated production processes to focusing more on core competencies and outsourcing component manufacturing and services. At the same time, industry consolidation has brought a mixed bag of supplier relationships and overcapacity. The industry is huge in any manner of measure. There are over 30 primary producers and over 2000 direct suppliers of products and services.

There are many major points driving the industry to further change. Today’s issues include:

- **Improved time to revenue**--The time required to bring a product to the market can be extensive. With a total cost for a new product launch estimated to be in the range of $1 billion plus, reducing the time to begin generating revenue is a significant objective. Down from 60 months only a few years ago, progress is being made but there is room for improvement.
- **Improved part traceability**--The liability and warranty issues in this industry require improved methods of component traceability. The objective is to provide for most major components a product history that identifies the complete sourcing and production history from any origination point within the supply chain to the end user.
- **Design for manufacture**--The area of product design has been an area of supplier collaboration for some time. Collaborative product development includes design for manufacturing input from supply chain sources that examine reduced assembly times and easier production complexity.
- **Modularization**--There has been continuing movement of outsourcing by the OEMs to larger components called modules where vendors assume responsibility for a fully functioning module and the correct delivery of that module to the assembly line in accordance with the build schedule. The OEM sets the meta-design rules that are used to guide the supplier in the product design and development, shifting the responsibility for supply chain product design and production coordination to the tier-one supplier.
- **Mass customization**--As the market looks for individualized vehicles (built to order versus built to a dealer inventory) the variety of product availability is increasing. This will require reexamining supplier arrangements and new ideas of inventory availability and transport. A current industry objective is to reduce lead times to produce a finished product from 30 days to 5 days from receipt of a product order.
- **Quality**--Current quality objectives are to reach reject levels of 2 parts per million.
- **Logistics**--The industry has set some objectives for suppliers to meet. They include shorter order lead times—as low as x hours in some instances—to match the assembly line schedule. On-time delivery of 98.5% and up is the norm. Material must be there.
Many of these issues are currently the focus of collaboration among automotive manufacturers and their suppliers. Collaboration has been a part of the industry practice for some time and there have been some bumps in the road, many that relate to information systems and data transfer. Progress is being made in this area with the work of the Automotive Industry Action Group (AIAG) and the Original Equipment Suppliers Association (OESA). AIAG is an association of companies within the automotive industry that focuses on enhancing business processes and practices involving trading partners throughout the supply chain. The association has published standards that address nearly every sector of the business. OESA is an association made up of suppliers to the industry and has many areas of interest particularly in the area of electronic commerce issues such as manufacturing collaboration and product development collaboration.

The industry is embarking on product lifecycle collaboration with very high ambitions. In product design the focus is on bringing together multiple decision makers early in the process. In chapter 6 an outline by the Original Equipment Suppliers Association (OESA) presents the business case scenario for the use of collaborative design tools. As a part of the education process the association is pursuing an effort to define external collaborative product design between customers and suppliers. Their definition of this activity is:

The complete set of extended enterprise activities required to support the manufacturing of new products, which includes advanced development through launch and lifecycle support.

**Product Development: Definition**

The complete set of extended enterprise activities required to support the manufacturing of new products which includes advanced development through launch and life cycle support.
According to a report from AMR Research, if design collaboration is executed flawlessly, the 10-year pay-off could exceed savings of $1,600 per finished vehicle. They do offer comments that this is not to be assumed as a fait accompli as there are many issues to address before the payoff is reached. Some of their estimates offer very interesting possibilities.

- Over 75% of the product cost is set upfront in the conceptual design phase.
- If products can be brought to market 50% faster, expenses associated with new vehicle programs can be cut 20% to 30% and the risk of missing the customer demand window is reduced.
- Design reuse can reduce vehicle program expenses through lower warranty costs; faster engineering time; better tooling, testing, and documentation; and can also reduce errors in all these functions.

In this same report AMR identified some specific areas of savings opportunities.

- Engineering Labor Efficiency--Engineering labor hours are estimated to be as little as 30 % efficient. By reducing meeting, travel, document search, error correction, and other non-value adding time engineering, efficiency will double to 60%.
- Engineering IT Support Costs--Dedicated IT personnel attached to engineering functions could be reduced with superior CAD integration tools and less hand integration to PDM and other systems.
- Engineering Travel Expenses--By allowing engineers on development teams to manage design meetings via the Web, travel expenses can be reduced by more than half.
- Warranty Expense--Increased design reuse will reduce warranty costs using more proven parts and components.
- Tooling Expense--Increased design reuse will reduce tooling costs by using more existing parts.
- Assembly Labor Expenses--Better design for manufacturability through the integration of CAD, BOM, and CAPE systems will reduce labors hours per vehicle.
- Direct Materials Cost--Increased design reuse, platform reuse, and part count reduction will allow lower cost sourcing by reducing the variability of demand to suppliers, purchasing leverage, and purchasing process costs.
- Feature-Driven Revenue--Faster and more comprehensive sharing of design concepts across engineering, manufacturing, and marketing will allow more value-added features to be cost effectively included in the final design, supporting higher final net sales prices
- Finished Goods Inventory--By extending vehicle platform reuse, postponement strategies will allow higher rates of manufacture-to-order which will reduce finished goods inventories.

The area of product design collaboration appears to offer significant opportunities to improve the product and the cost structure not only at the design phase but also through the life of the product by including field information from the customer. There are a few obstacles in the way as noted in the AMR report, including the resistance to change and intellectual property issues. It will not be easy but the opportunities appear to be well worth the effort.

Production/inventory synchronization in this industry is known as demand collaboration. The goal of demand collaboration is to move the planning system bill-of-material explosion process out from behind the four-walls of the OEM into an industry portal (public marketplace). Here, an OEM would publish their demand, the material requirements explosion would occur, and the suppliers would then review the demand and respond back as to whether or not they can meet it. If somewhere in the supply chain a supplier cannot meet the demand, their customer can then act accordingly to source additional parts from a competitor, move the demand forward in the schedule if additional capacity at the supplier exists, etc. The goal is to identify bottlenecks and smooth out forecasts before they affect the process.

There are, however, significant challenges to demand collaboration. For demand to be properly calculated, everyone in the supply chain must update inventory, shipments, receipts, usages, and yields using real-time information both to identify and to confirm the current actual condition, all prior to the bill-of-material requirements explosion. If this information is not current, results of the requirements explosion will be incorrect and the collaboration process will be more of a data entry exercise to update the demand manually.
The Original Equipment Suppliers Association is working to address opportunities in this area through their Supply Chain Management Study Group. The study group lists these items as requirements:

- Create visibility throughout the supply chain.
- Automate activities.
- Provide alert messaging to support management by exception.
- Supplier electronic communication.
- Be able to collaborate electronically through the use of technology tools that:
  - Improve information velocity.
  - Provide information visibility.
  - Provide information aggregation.
  - Enable vertical collaboration.

In distribution/order fulfillment, the CPFR® guidelines are starting to gain traction. Many of the OEMs have already begun to implement vendor-managed inventory programs. While most of these implementations have focused on the stores items (nuts, bolts, gloves, offices supplies, etc.), implementations are starting to occur for purchased parts and raw materials. Some companies are now using vendor managed inventory systems to communicate updated inventory status on an hourly basis.

One problem in this area is that information being communicated to the supplier is frequently not current as many companies maintain the perpetual inventory data in their ERP systems, the primary information source for vendor-managed inventory applications. Because many companies do not yet report shop floor information on a real-time basis (production numbers are usually reported at the end of a shift or run), the data in the ERP systems may not be current. Effective manufacturing collaboration requires on-line data from the production processes to ensure all systems are working with current information.

Another complication of collaboration is the suppliers’ requirement to subscribe to multiple software systems either through an application service provider model or by investing in an enterprise user license. Depending upon which system their customer is using, suppliers will need to use the appropriate front-end applications to receive and process the data. If the software system on the buyer’s side is different from what the supplier has in place, the cost to transfer the information can be quite high and beyond any value to the supplier.

Suppliers are working together through Automotive Industry Action Group (AIAG) and are looking at ways to reduce these costs. Their goal is to get the software vendors together to develop a common data format using XML. This common format is a major key to allow these disparate applications to talk to one another. Trying to get the numerous companies to work with each other and agree upon a common format is going to be a significant challenge but there seems to be mutual agreement among vendors that this must occur.

A collaborative competitive advantage can be gained when suppliers join together for a defined project and length of time to jointly develop and build a particular module. Similar to contract manufacturing in the electronics industry, automotive OEMs are starting to require their tier-one suppliers to become full-system suppliers by accepting the responsibility to design and build a module and each of its components. Each of the next-tier suppliers will then be responsible for making their component and providing it to the tier-one to assemble and ship. This use of collaboration can be seen with Daimler-Chrysler and some of their suppliers at their truck plant in Brazil where Dana Corporation provides one of seventeen different rolling chassis designs to the assembly plant within a two-hour lead-time. At this same plant Lear Corporation provides an interior module that includes seats, carpet, sun visors, and back panels. These are long term commitments to collaboration that require on-line real time information systems to maintain synchronized production and inventory information between the two immediate companies as well as other suppliers.

Although standards have been developed, EDI tools have not been implemented very deep in the supply chain. One of the concerns in this industry is how lower-tier suppliers will react to the requirement for closer collaboration through electronic connections. To gain an understanding of the perception that usage was bottlenecked at the second-tier level, a study was done by the Automotive Industry Action Group (AIAG) to
determine what barriers were keeping companies from embracing this technology. The study found it was not only technology or cost barriers but included trust issues such as these:

- Unstable relationships with higher-tier customers.
- A lack of confidence in industry initiatives.
- A concern for upper-tier process inconsistency.
- Little information as to future plans and strategies provided to most lower-tier suppliers.
- A lack of loyalty by upper-tier customers to their suppliers.

The ideas behind closer information transfer appear to be cost effective but the trust environment presents considerable weight against investing in something that is not embraced by the broader range of supply chain partners. Another negative effect has been data integrity, as information that has been available has not been reliable. The result is that suppliers are still making telephone calls to get the “real information.”

New technology and the Internet are seen as important new tools to improve information availability and enable closer supplier integration. By automating manual activities and by developing the ability to collaborate electronically with real-time information from the production processes, the supply chain network is improved. The industry has been a magnet for information system ideas that would provide improvement. This has resulted in systems being custom developed for specific applications that were very expensive and not very reliable. The industry is looking for improvement but, like most industries, it is necessary to have well defined solutions that have evolved to a level of performance, reliability, and cost, that ensure successful use by all levels of the supply chain. A wide consensus exists that software systems in general have not yet matured to the point that suits the broader issues of this industry. As companies extend to a global reach looking to increase their customer base, they must be able to implement best-of-breed systems and adapt their current business processes accordingly.

The expectation is that the supply chain network will evolve to a pure hub-and-spoke model to meet the varying needs of the automotive industry. This model, shown in Figure 13.3, will provide the ability to accelerate electronic communications, share information collaboratively, build industry leadership, drive technology solutions, develop automotive industry standards, and be an important step toward the 5-day car.
The future holds interesting challenges. One of these is the trend from non-modular to modular design, building, and shipping of components. The non-modular approach has made it relatively easy for an OEM to switch suppliers. Modularization will require suppliers to have a greater investment in dollars and knowledge, making it more difficult for an OEM to replace a supplier, and thus increasing their bargaining power. Another challenge is the move toward the build-to-order or x-day car that is going to lead a major transition from just-in-time parts delivery to build-on-demand/order-to-delivery, giving greater impetus to modularization.

With Internet-mediated procurement, and rapid, low cost dissemination of information, suppliers’ relationships with the OEMs are likely to change. The relationship is expected to become less personal with real-time information systems as the main conduit for production requirements demand information, and plant floor systems as the source of information that confirms the virtual inventory is available according to plan.

The full impact of the Internet has not yet been determined. The benefits, such as speed, accuracy, and improved communications, are necessary to support the numerous initiatives of the OEMs. The expectation is that companies that can adapt technology changes most rapidly will be the ones to grow and increase market share as improved production results through applied technology can be the differentiator between competitors.

The automotive industry, especially Toyota and Chrysler, has defined early collaboration relationships. As the industry moves through consolidation to reduce overcapacity, works to reduce the time and cost to bring a new product to market, and reaches toward the five- or even ten-day car, the need to employ closer collaboration with all of their partners will be a cornerstone of their progress. Supply chains are likely to become closer and more identifiable as competing units, requiring tighter and more accurate information management to ensure that each process of the system is in proper synchronization with every other process through delivery to the customer. Collaboration is alive and well in the automotive industry and still has a long way to go.
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