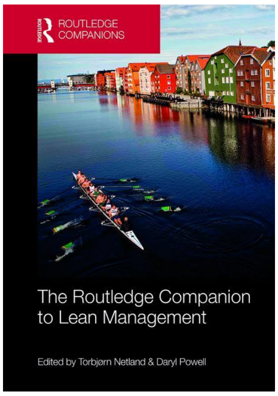

The Routledge Companion to Lean Management

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Lean Logistics

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8

LEAN LOGISTICS

Michel Baudin

Introduction

In lieu of an introduction, the following paragraphs are a précis of the chapter, which is itself a précis of the book by the same title (Baudin, 2005), giving you three options in depth of coverage.

Logistics comprises all the operations needed to deliver goods or services, *except* making of the actual goods or performing the services. In manufacturing, it covers material flows between plants and between production lines within a plant. It also includes information flows generated by processing of transactions associated with material flows, analysis of past activity, forecasting, and planning and scheduling of future activity, as well as fund flows triggered by the movements of goods and information.

Lean logistics is the logistics dimension of lean manufacturing. The logistics organization is the pit crew to production's race car driver. Its first objective is to deliver the right materials to the right locations, in the right quantities, and in the right presentation; its second, to do all of it efficiently. *Outbound logistics* is organized to serve as a source of market intelligence. Shortages are prevented by vigilance rather than inventory.

Lean logistics tailors approaches to demand structures of different items, as opposed to one-size-fits-all. It is a pull system: materials move when the destination signals that it is ready for them (Sugimori et al., 1977). Moving small quantities of many items between and within plants with short, predictable lead times requires pickups and deliveries at fixed times along fixed routes called "*milk runs*." In turn, this supports the use of returnable containers.

Information systems for lean logistics combine visible management with computer systems. Toyota uses a worldwide network for logistics and markets in Japan through an internet portal (Fujimoto, 1999; Iyer et al., 2009). Production planning/scheduling involves leveled sequencing and pull systems, and uses the capabilities engineered into the shop floor. Materials requirements planning (MRP) provides suppliers with forecasts, *electronic data interchange* (EDI) and kanbans are used to issue orders, and auto-ID helps maintain inventory accuracy (Louis, 1997).

Option-specific components are ordered through the body-on-sequence system, and responsibility for commodities is delegated to suppliers through vendor-managed inventory or consignment. Suppliers are organized in tiers, and used as single sources. Customer/supplier collaboration extends from product design to emergency response, and suppliers organize mutual support in improvement efforts.

Objectives of Lean Logistics

The objectives of any business organization can be summarized in different ways from different perspectives. For manufacturing logistics, the most relevant are what we call “the two Fs”: effectiveness and efficiency. Being effective, as Peter Drucker (2007) put it, means getting the right things done; being efficient means doing them without wasting resources. Effectiveness is about the “what”; efficiency, about the “how.” Obviously, effectiveness takes priority, and efficiency at doing the wrong things is not an objective worth pursuing. Yet this is what most material managers in manufacturing companies are doing, when they worry more about keeping trucks full and forklift operators busy than about delivering the right parts in the right quantities at the right time and in the right presentation to production.

On the outbound side, a customer who orders a case is not usually forced to accept a truckload. However, in production, an operation that needs a small bin of parts—even if this bin must be fully stocked—sees full pallets arrive still shrink-wrapped, simply because it is convenient for the forklift driver to deliver them at that time and in that form.

By definition, logistics does not transform materials. Many lean manufacturing authors conclude from this that there is no value added in logistics. Logistics authors counter that, arguing that logistics provides the value of time and place. In addition, we also see value in presentation. These three types of logistics value added are dramatized with extreme examples in Figure 8.1:

- A beautiful maternity ward ready six months from now is no use if you are in labor today.
- Your bicycle is worth more in your hands at the start of the race than 50 miles away.
- Bullets in a sealed box offer no protection against a pouncing lion.

Figure 8.1 The value of time, place, and presentation

Source: Baudin (2005).

For the manufacturing organization as a whole, there is much more at stake in the quality of the service provided by the logistics organization than in the productivity of its members or the utilization of its equipment and facilities. Logistics operations occupy more space than production and are therefore highly visible. However, production operators outnumber logistics personnel about 10 to 1, and production machinery and its supporting facilities also represent an investment that is an order of magnitude larger than that used for transportation, storage, and retrieval.

If there is one forklift driver too many, the cost to the organization is in the tens of thousands of dollars per year, but shortages can cost millions. Yet, in his analysis of logistics performance, Frazelle (2002) proposes measures of logistics performance covering costs, productivity, quality, and responsiveness, but without ever suggesting that quality and responsiveness, measuring effectiveness, should be addressed before considering addressing costs and productivity related to efficiency.

In lean logistics, the functions of *materials supply and production* are not treated at the same level. As discussed in my book *Lean Assembly* (Baudin, 2002), materials supply is the pit crew to production's race car driver. Adopting this perspective does not mean neglecting efficiency, only putting it where it belongs: to be addressed after effectiveness.

The objectives of lean logistics can therefore be stated as follows:

1 Delivering the materials needed, when needed, in the exact quantity needed, and conveniently presented, to production for inbound logistics and to customers for outbound logistics.
2 Without degrading delivery, pursue the elimination of waste in the logistics process.

Inbound logistics is production's pit crew, and its emphasis is on the level of materials service as opposed to the efficiency with which it is provided. This is a key driver of lean logistics and the rationale behind many of its features.

Material Flow Concepts of Lean Logistics

First, outbound logistics is a source of market intelligence. Since outbound logistics is the tail end of the order fulfillment process and deliveries trigger the collection of revenue, there is generally no confusion within the company regarding the importance of this activity. There is, however, one aspect of it that makes it different from a mirror image of inbound logistics, and that is its role as a source of market intelligence.

Many companies, and not just lean manufacturers, mine their sales data. What is, however, specific to lean manufacturing is the realization that the physical organization of distribution can act as a screen, blocking access to market information and the design of creative ways to remove or work around these screens.

Second, lean logistics prevents shortages through vigilance, not inventory. Whether raw materials, work in process, or finished goods, the rationale for keeping inventory is shortage prevention. While keeping large stocks of coal, iron ore, or petroleum may work for this purpose, this approach breaks down as the product mix and the variety of materials and components used increase. Instead of a secure supply, the result, known as "*the paradox of stock*," is warehouses that are full and contain ample supplies of all but one of the items needed for a product. As a result, not a single unit can be assembled and shipped.

The lean approach is instead to hold the minimum needed to support production but monitor it closely, plan production to smooth the consumption rate of each item over time, organize inbound logistics to make replenishment lead times more predictable, and respond with countermeasures at the first sign of problems. Spectacular examples of this approach include how

Toyota was able to maintain supply of parts from the Midwest to NUMMI throughout the Mississippi flood of 1993 and to restore full production in six weeks after the Aisin Seiki fire of 1997 cut off 99 percent of the supply of proportioning valves in Japan.

Logistics must be Tailored to Specific Needs, not One-size-fits-all

Most manufacturing organizations have only one way to do the work of logistics. One common pattern for inbound operations inside the plant is as follows:

1. Parts come in full truckloads from one supplier in each truck.
2. Operators use forklifts to unload the truck one pallet at a time.
3. After receiving, forklift operators put away pallets into single-deep pallet racks into any available slot, and log the location with a radio terminal.
4. The computer system issues work orders or routing slips.
5. The forklift operators retrieve full pallets from the warehouse and log this operation with a radio terminal.
6. They deliver full pallets wherever they can find space to set them down near the destination production area.

The same pattern is applied to all items, regardless of required quantities or frequency of use. The logistics organization is attached to this one-size-fits-all approach. Its management is particularly concerned that its members may not be able to deal with the complexity associated with a different approach for each category of items.

The lean logistics perspective is the opposite. Regardless of which single approach is chosen, it will be effective and efficient for some items and neither for others. If an assembly line consumes a pallet of an item every 20 minutes, then it makes sense to deliver this item by the pallet load. If, for a different item, a pallet holds 12 boxes and one box lasts a week, then deliveries should be for no more than one box. Since it makes no sense to use a forklift to deliver one box, other means of transportation should be used, such as a cart that can hold a mixed load of boxes of different items. Understandably, tailoring the approach to the needs results in a more complicated system, and the logistics organization may need more training to cope with it.

Milk Runs Smooth the Flows

The need to move small quantities of a large number of items both between and within plants with short, predictable lead times and without multiplying transportation costs has driven lean manufacturers to organize pickups and deliveries at fixed times along fixed routes called "milk runs." The term is a reference to the system used for home delivery of milk in the US until the 1960s. It is in fact not the standard meaning of "milk run," which is aviation slang for an easy trip, similar to a "cake walk." As shown in Figure 8.2, the milk run concept applies in different forms to inbound, outbound, and in-plant logistics, at least for some of the items consumed or produced.

Other metaphors could have been used to describe this approach. Inside a plant, dispatching forklifts on request to pickup locations can be viewed as a taxi system. On the contrary, milk runs can be viewed as buses, picking up and dropping off passengers at a series of stops at fixed intervals on regular routes. In Japan, this system is known as *junkai* (巡回), which means "tour."

The milk run concept is largely ignored in the logistics literature, and barely mentioned even in the literature on lean manufacturing in English. In Japan, it is described in articles in the magazine *Kojo Kanri* (Factory Management, published by Nikkan Kogyo Shimbunshu).

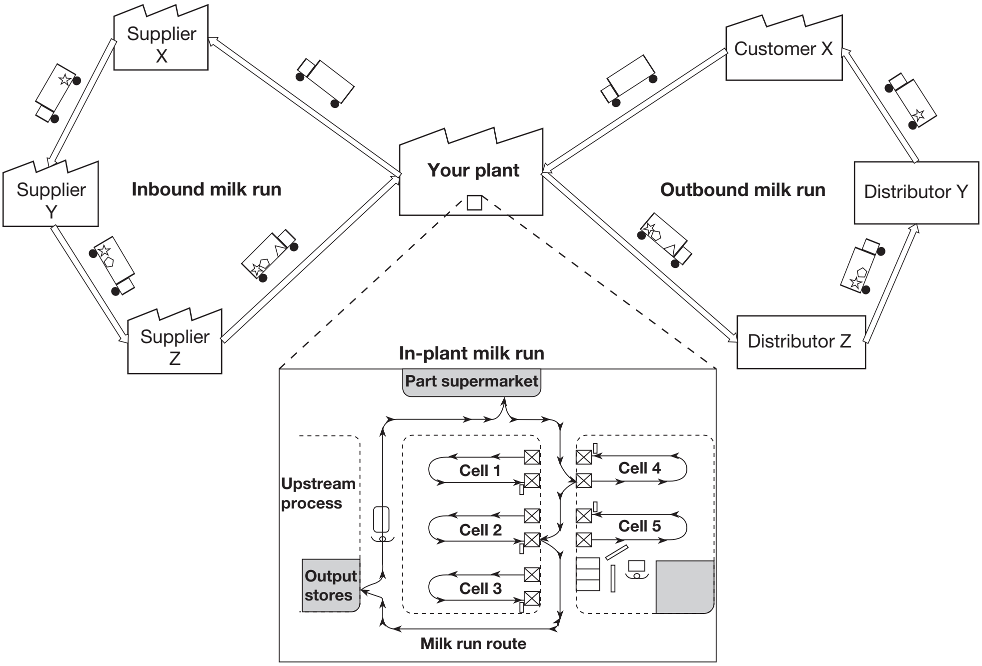

Figure 8.2 Inbound, outbound, and in-plant milk runs

Source: Baudin (2005).

Returnable Containers Improve Part Protection and Cut Costs

Until the 1960s, such foods as milk, yoghurt or beer were sold to consumers primarily in returnable bottles or jars, but the trend since then has been towards disposable containers. Some local breweries in Germany still use returnable bottles, and the reusable industry still has a foothold in many European countries. Today, however, the closest most companies get to reusing packages is recycling the materials they are made of.

In this context, it comes as a surprise that lean manufacturers are going in the opposite direction and favoring returnable over disposable containers for packaging parts in transit. In automobile plants, returnable plastic bins now dominate, even for shipments from overseas, and cartons are a vanishing minority. In other industries, one also sees plants where suppliers' disposable containers do not make it past receiving or past a consolidation center, and where parts are transferred to returnable bins at the point of entry.

There are many reasons for this:

1. Provided returnable containers are handled with sufficient care to make 20 round trips or more, they are cheaper to use than single-use containers that must be disposed of in an environmentally acceptable way.
2. Returnable containers can be fitted with item-specific dunnage that effectively protects the parts from one another, prevents operators from inserting wrong items, and makes the parts easier to count. However, item-specific dunnage is too expensive to be used only once.
3. Collecting returnable containers from industrial customers is easier than from consumers, because there are fewer of them, and milk runs provide an infrastructure for the return flow of empties.

4 The number of returnable containers in circulation for an item is controlled and caps the number of parts in the pipeline.

Like milk runs, however, returnable containers have yet to receive any attention in the literature on lean manufacturing and logistics. This may be due to the numerous practical challenges implementers face in managing the return flow of containers in usable condition at the right locations.

Information Flow Concepts of Lean Logistics

The material flow systems provide the muscles; the information flow system, the nerves. This section outlines the key concepts of the information systems that are part of lean logistics.

Lean Logistics is a Pull System

Lean manufacturing is often described as a "pull system," as opposed to the "push system" it replaces. This distinction is only relevant in the logistics domain. It is no more applicable to conveyance within a production line than to water flow within a pipe. However, it is applicable to the transportation of parts between plants or between lines within a plant.

The distinction between a pull and a push system is then simple (see Figure 8.3):

- In a pull system, parts do not move until the destination plant or production line signals that it is ready for them.
- In a push system, parts move as soon as they are ready, regardless of the conditions in the destination plant or line.

Many managers fail to work out the logical consequences of the pull concept. They want parts to move on as soon as they are ready, because they assume it will get them out the door in finished goods faster. However, in a pull system this is not supposed to happen. Instead, the parts stay in the output buffer of the line until a pull signal arrives. This output buffer is located right at the end of the line where it is visible, not in a separate room. If the line's production runs are for pallets and the pull signals for individual boxes, then boxes are what moves, as shown in Figure 8.4. The output buffer works like a retail store, from which the next line "buys" parts by issuing pull signals, and in which the parts that have not yet been bought remain on the shelves.

The pull system is an adaptation of commercial market mechanisms, where money is the pull signal. The move to a pull system on the shop floor is a partial reversal of the trend observed from the 1840s to the 1970s, away from market mechanisms and toward what Alfred Chandler called *the visible hand* of management to allocate resources and work within companies and industries.

The attempt to use MRP to plan and schedule the shop floor can be seen as the extreme of the visible hand reaching into operational details and prescribing from a central location which parts should be run when through each machine.

Pull systems allow local decisions to be made locally, using a logic that makes these decisions naturally consistent with global business needs. The concept is simple; making it work on the ground, with actual products, processes, people, and equipment is not.

Pull signals can take on a variety of forms, from empty containers or fixtures to cards called kanbans and electronic signals. We will discuss the selection of appropriate types for each application.

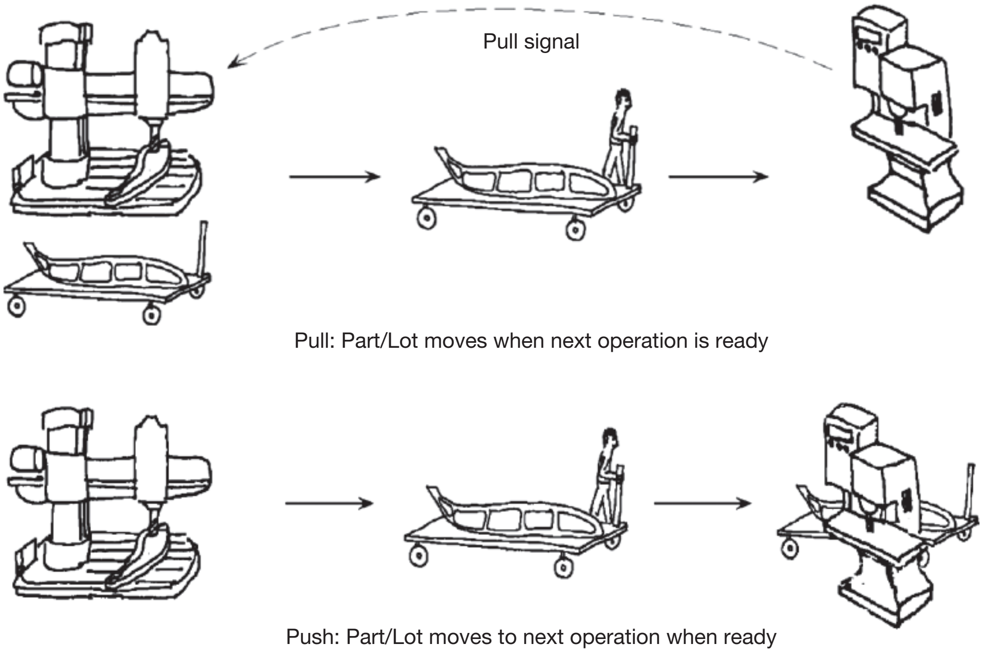

Figure 8.3 Push and pull concepts

Source: Baudin (2005).

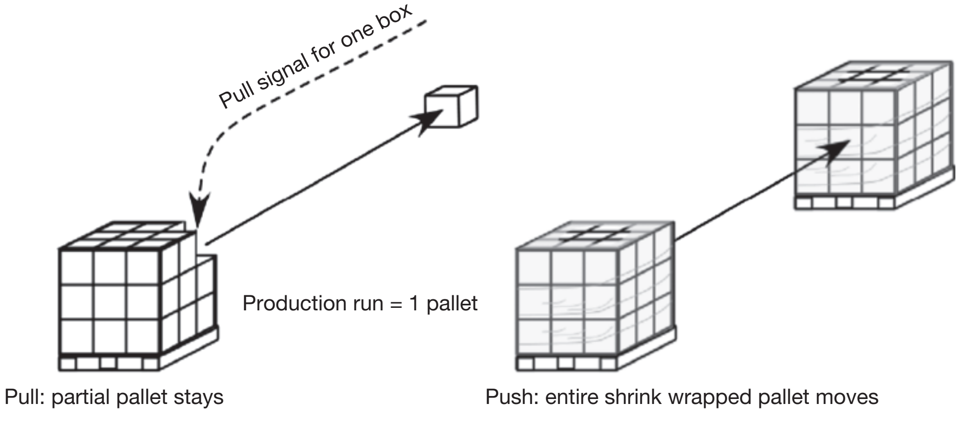

Figure 8.4 Quantities moved in pull versus push system

Source: Baudin (2005).

Information system = visible management + computer systems

In most businesses today, "information system" is synonymous with "computer system." However, in lean manufacturing, the information system combines visible management with computer systems. Successful 5S projects make plants not only clean but easy to navigate. A first-time visitor to a well-lit, clearly marked neighborhood supermarket can find butter without

Unmarked aisle

Marked aisle

Figure 8.5 Visible management in a supermarket

Source: Baudin (2005).

asking for help. However, the challenge of locating an item in an uncharted warehouse makes the maintenance of an accurate inventory database all but impossible. The difference is highlighted in Figure 8.5.

The computers available when lean manufacturing pioneer Taiichi Ohno was professionally active could not do much that was useful in a factory. If you tried to use them, the care and feeding of the computer systems became your full-time occupation, and applications that could justify their costs never materialized. It is little wonder that Ohno had little use for these machines. Many current practitioners of lean manufacturing retain an anti-computer bias to this day. While it is possible even for today's tools to become time sinks and money pits, they can be productivity boosters.

In 2000, Toyota launched its own internet portal named "Gazoo," with the goal of getting its fingers on the pulse of the market again. In its early days, Toyota sold cars in Japan door to door. This method was later abandoned as too expensive, but it had the advantage of providing better market intelligence than dealers. Gazoo restores this market visibility by allowing car users to communicate with Toyota through their clicks.

Production Planning and Scheduling

The order fulfillment process is industry-specific, and there is therefore no single approach that can be called "lean planning and scheduling." Instead, there are common principles that are applied in different ways depending on circumstances. Toyota's production planning and scheduling methods blend a flow of consumer orders aggregated through dealers into a final assembly leveled sequence. The assembly leveled sequence execution pulls parts in and triggers the production of thousands of items up the supply chain. This works for cars. To make injection-moulded plastic parts from a single resin, there is also a lean way to plan and schedule production. However, most of the specific features used for car assembly are irrelevant. Table 8.1 describes underlying principles that can be used across industries.

The Role of Manufacturing Execution Systems in Lean Logistics

Many enterprise resource planning (ERP) systems have modules to track shop floor activity. These modules have historically been ineffective, leading to the creation of another class of software, called *manufacturing execution systems* (MES), to fill the gap.

Lean manufacturing makes materials easier to track through the plant and the supplier network. Further, it makes tracking vital as a tool to exercise vigilance in preventing shortages.

In flow lines and cells, there is a visible mapping from physical location to process status. Since there is no backtracking or eddy flow, simply seeing where a part is enables you to tell exactly which operations already have been undergone and which still remain. Also, since parts through the line move one at a time, first-in-first-out, the time at which a part completed an operation can be inferred from data about the complete production run. If moves between lines are triggered by kanbans, then the "traveler" documents that accompany parts in job shops can be eliminated for all standard products. They will only survive in the form of "build manifests" for products with options or customization.

The MES is then used to print the kanbans and build manifests based on the *bills of materials* (BOM) in the ERP or the technical data management system.

While visibility on the shop floor eliminates work in process (WIP) tracking transactions through every operation in the computer system, the need remains for materials to check in and out of warehouse locations. Without this, it is impossible to maintain accurate inventory data.

Since, in principle, it tracks physical flows, the MES also should, but in most plants does not, have a key role in preventing shortages. Knowing how much of an item is on hand, the rate at which it is consumed, and the delivery schedule, it should be able to anticipate shortages and issue warnings to managers in a position to launch countermeasures. Yet even in factories with multimillion-dollar information systems budgets, shortages are not discovered until an operator reaches for a part and can't find one.

Monitoring Supplier Performance

The history of transactions with each supplier is summarized into supplier performance metrics that are used to certify suppliers. Suppliers are certified as trustworthy, needing assistance or guidance to achieve the certification, or as candidates for replacement.

The prices suppliers charge is what purchasing traditionally pays the most attention to, among other reasons because price data is the most readily available. Collecting performance data on delivery and quality is necessary to keep the company from hurting itself by always choosing the lowest bidder.

In most plants, the data to perform the required analysis exists, and what is lacking is the will to mine this data for multiple dimensions of supplier performance, categorize suppliers based on the results, and develop appropriate policies for each category.

Table 8.1 Principles for production planning and control in lean logistics

#1 Separate rate work and response work.	In telling the plant what to make, when to make it, and with what resources, the lean approach is also tailored to the different types of demand the plant faces. One key distinction is between items made on a routine basis, which we call "rate work," and items made irregularly, on request, which we call "response work." It is based on the product-quantity (P-Q) and seasonality analysis. It leads to the classification of products and their components and materials into A, B, and C categories, and the rate work comprises the A products with their dedicated production lines and the B products with dedicated lines by product family. Together, the A and B products usually account for more than 90% of the total volume. The C products are the low-volume-high-mix response work. Scheduling A products is then simply a matter of adjusting the volume. For B products, it means sequencing the items through the production line with goals that may be maximizing output, minimizing work in process (WIP), or smoothing the flow of incoming materials. Orders for C products are treated like individual projects and made from scratch.
#2 Don't play priority games with WIP in rate work.	Even rate work first comes in in the form of customer orders, which can be shuffled every which way until they are released to production. Past this point, materials are committed and the work proceeds first-in-first-out until the complete order emerges from production. This is possible because lean engineering of the production process and the use of a pull system have made production lead times short for all orders. If the plant is fully booked, order lead times may be extended, but the waiting happens before production starts, not in mid-stream. Exception handling, by definition, is response work, done on resources or in time allocated for this purpose, and is not allowed to interfere with rate work.
#3 Avoid starting production with missing parts.	Performing partial assembly of goods with missing components creates stocks of units that are "99% complete" but still cannot be shipped, as well as complicated, error-prone catch-up operations. Short production lead times also enable the manufacturer, if not to terminate this practice altogether, at least to restrict it to brief shortages of non-safety-related parts that can be installed in an otherwise complete unit. On a car, a trunk lock satisfies these conditions, but a proportioning valve doesn't: it distributes brake fluid to the wheels, which is related to safety, and is mounted in a location that is not easily accessible. And indeed, when the Aisin Seiki plant in Kariya burned on February 1, 1997, depriving Toyota of 99% of its supply of proportioning valves in Japan, the Toyota assembly plants shut down within four hours rather than attempt to build cars with this part missing to add it later. Of course, validating a sequence of product units to build during a shift against available stock is technically feasible given an accurate database but, oddly, is not done by ERP systems but by advanced planning and scheduling (APS) systems.

Table 8.1 (continued)

	This validation, however, is insufficient, because product units may be built during the shift using parts that are not yet available at the time of the planning run. The parts delivered on a 10:00AM milk run, for example, can be assumed available for production by 12:00PM but are not in-hand at 6:30AM when the schedule is generated. To the best of our knowledge, this level of complexity is not handled by the software available as of this writing.
#4 Integrate production planning and scheduling with the pull system.	With a pull system, explicit scheduling of the work is needed only at the top of the supply chain —the start of final assembly in car making — with pull signals conveying the required information upstream. To the recipients of the pull signals, however, they constitute a demand, to which they may respond by explicitly scheduling their own production resources. The net result is not the elimination of the need to schedule but its decentralization. Not only is the problem of scheduling a cell of five workstations intrinsically easier than that of scheduling a plant with hundreds of machines and thousands of part items, but the detailed structure of a cell and the information about operator skills, process, and setup times can be better handled locally by a cell leader or a scheduler attached to a supervisor than globally by a central computer system. To the extent its discipline is followed, the pull system prevents local scheduling from pursuing goals that are not in the best interest of the plant as a whole, and the use of various forms of levelled sequencing, where applicable, dampens the bullwhip effect.
#5 Exchange information with suppliers.	In lean logistics, supplier communications go far beyond commercial transactions. The following paragraphs explain the key additional elements
#6 Use MRP for forecasting.	MRP, in the original sense of materials requirements planning, is performed in lean manufacturing as well as everywhere else. The difference is in the use of the output. In lean manufacturing, MRP is used strictly to translate forecasts of finished goods demand into forecasts of materials requirements, for suppliers to act upon as they see fit. While these forecasts are not orders, the agreements with suppliers usually include compensation for suppliers when consistently optimistic forecasts make them buy excess materials.
#7 Use EDI and kanbans as needed	Kanbans are recirculating physical tokens, most often cards, that serve as pull signals and have been used by Toyota as a means of issuing orders to suppliers for some items since 1949. Fifty-four years later, while most manufacturing companies have yet to master the logic of the kanban system, its implementers are challenged to take advantage of increasingly effective computer and communication technology. Human-readable tokens still need to be attached to containers but they must also be machine-readable through barcodes or RFID tags, and the pull signals issued based on the kanban system's replenishment logic using EDI technology

(*Continued*)

Table 8.1 (continued)

#8 Apply body-on-sequence as needed	In the automobile industry, some model and option dependent components made by local suppliers are ordered by electronically feeding them the exact start sequence of cars started on the first station of final assembly. The supplier then starts making the components, knowing that they must be delivered to the required station on the final assembly line within, say, 214 minutes. "Body-on-sequence" is the term used for this system at Toyota and NUMMI; Ford calls it "in-line vehicle sequencing."
#9 Use vendor-managed inventory and consignment/pay-per-build as needed.	At the opposite end of the parts spectrum are commodities like nuts, bolts, and washers, for which customers like to delegate as much responsibility as possible to suppliers. In vendor-managed inventory, the supplier is given access to the customer's inventory database and is allowed to initiate shipments when reorder points are crossed. Consignment arrangements delegate more responsibility, by letting the supplier own the stocks in the customer's plant until the parts are used, and, in the pay-per-build scheme, suppliers are paid based on the quantities of their parts incorporated in finished goods leaving the production line, per the bill of materials.

Collaborative Supplier/Customer Relationships

The relationships between suppliers and customers have received more attention in the press and the literature than the more technical aspects of lean logistics outlined above. The lean approach to managing supplier/customer relations, however, goes hand in hand with milk runs, pull systems, and the other approaches I have covered.

A lean supplier network has the following characteristics:

1 *A small number of direct suppliers with a tier structure*. Lean manufacturers rely on a tier structure allowing each large supplier to manage a group of smaller ones.
2 *Single sourcing*. Lean manufacturers do not use the strategy of sourcing the same item from multiple suppliers to assure supply. The single-source suppliers may make their own second-sourcing agreements but they retain sole responsibility for the supply of the item.
3 *Collaboration in product design*. The more complex a manufactured product is, the less sense it makes to treat its components like commodities. Instead, they are specific to the product and designed for it, and better, cheaper, and more manufacturable designs result when the engineering teams of suppliers and customers collaborate during design in target costing, value engineering, and *design for manufacturing and assembly* (DFMA).
4 *Collaboration in cost reduction during production*. During production, suppliers and customers work together to reduce costs through a process called *kaizen costing,* in which the customer provides technical assistance in exchange for price breaks.
5 *Collaboration in problem solving and emergency response*. Lean manufacturers do not look for suppliers who "never have any problems" but for suppliers who don't hide them and are diligent about solving them, particularly when they are emergencies. If a key piece of equipment breaks down and cannot be repaired right away, the supplier notifies the customer immediately. If the breakdown was due to human error, a mistake-proofing device is implemented within a week.

6 *A community*. The suppliers of a lean manufacturer are an organized community. Suppliers to NUMMI participate in the Golden State Automotive Manufacturers Association (GAMA); suppliers to Toyota in Kentucky, in the Bluegrass Automotive Manufacturers Association (BAMA); suppliers to Applied Materials, in its Lean Suppliers Association (LSA). These groups hold conferences, visit each other's plants, and, in the case of Toyota, contribute to each other's improvement projects through activities called *jishuken*.

This approach originated in the automobile industry, in which leadership and initiative rest with the car makers who assemble the final product. This is not a universal pattern. Computer industry companies, by contrast, follow the lead of software and chip suppliers for product design, and of chip suppliers—particularly microprocessors and memories—in logistics.

Conclusions

Since 2005, lean logistics has become a topic in its own right, and treated as if it were independent of the manufacturing activity it serves. It is, however, nothing of the kind, and pretending it is does not lead to success in implementing it. If you are pursuing lean in machining, fabrication, or assembly, then lean logistics is a necessary complement. Otherwise, there is no sense in pursuing it.

The technology of information changes much faster than the technology of materials handling, storage and retrieval, and transportation. When new technology is introduced in logistics, it automates existing methods and concepts. Later, it enables the development of new concepts. Barcodes took 30 years to become widespread as a means of automating basic warehouse management transactions; then it dawned on some users that they could be used to make shop floor objects self-identifying.

Today the *internet of things* (IoT) is seen as a means of taking it further. If these visions materialize, it will eventually lead to new concepts in logistics that may enhance or replace today's lean logistics, but I won't venture a prediction on how long this will take.

Case Study: From Forklifts to Small Trains

This happened in a 50-year old plant with about 1,000 employees, making large mechanical assemblies at the rate of about 100 units per day, involving thousands of parts and extensive customization. This plant is alive and well today.

Seven years ago, on the production shop floor, you saw traffic jams of forklifts, a sign that a plant is overusing this means of moving materials. The organization had no experience with any other method, with the forklifts delivering either pallets or pallet-sized, stackable bins, from which operators struggled to retrieve parts. The transportation aisles were not clearly marked and the forklifts penetrated the operators' workspace in the production area, causing frequent accidents.

It was like a city using taxis for mass transit. For millions of commuters making the same trips every day, trains and buses work better. The production lines consumed many of the same parts every day, at rates that did not vary massively from one day to the next. Rather than forklifts making unsolicited deliveries or calling for a forklift when running low, it would have been better to have deliveries at a regular pitch, in quantities that were just enough to feed the line until the next scheduled delivery. It required different equipment, like small trains and customized carts, and a higher level of organization and discipline. The key challenge was starting this transformation.

In this particular case, the plant manager had led a delegation on a tour of another plant and seen a small-train system in operation. He had then made the commitment to implement it back home. The *materials manager* in charge of in-plant transportation, however, was "too busy" to take on this project. This put the plant manager in a quandary. He could replace the materials manager, but he was a long-term employee whose contributions had, up to this point, been highly rated. Even if he was not fired, being removed from this position would not only be a blow to him, but would also affect the morale of the whole organization. On the other hand, if he were left in charge, nothing would happen.

However, the plant manager felt that the key was for the organization to gain experience with small trains and milk runs and he put production in charge of a pilot project, with help from the newly established kaizen office. For the target segment of the production line, materials management would still deliver pallets or large bins, but not to the line side. Instead, they were delivered to an area set aside for this purpose in one of the warehouses, where a team from production would pick parts from the bins and arrange them on a small train for delivery to the line.

As it added a step, it was not efficient, but it achieved the goal. The team bought a tugger and carts with connected axles to follow the tugger in turns, and a Creform starter kit to build structures on the carts. They chose to make a run every 30 minutes, not as a result of calculations but because it was the pitch they had seen used in their plant visit. They later adjusted it to the line's needs.

The inventory that cluttered the workspace around the target production line was removed. It not only made its operations visible, but it also enabled the production team to rearrange feeder operations into cells. The resulting improvements more than paid for the extra handling step. Five years later, most of the movements of materials inside the plant were through milk runs of small trains. Most of the forklift leases were terminated, but a few were retained. After all, even a city with a mass transit system still needs a few taxis.

References

Baudin, M. (2002). *Lean Assembly: The Nuts and Bolts of Making Assembly Operations Flow*, Portland, OR, Productivity Press.

Baudin, M. (2005). *Lean Logistics*, Portland, OR, Productivity Press.

Drucker, P. F. (2007). *Management Challenges for the 21st Century*, Amsterdam, Butterworth-Heinemann.

Frazelle, E. H. (2002). *Supply Chain Strategy*, New York, McGraw-Hill.

Fujimoto, T. (1999). *The Evolution of a Manufacturing System at Toyota*, Oxford, Oxford University Press.

Iyer, A., Seshadi, S. and Vasher, R. (2009) *Toyota Supply Chain Management*, New York, McGraw-Hill.

Louis, R. S. (1997) *Integrating Kanban with MRP-II*, Portland, OR, Productivity Press.

Sugimori, Y., Kusunoki, K., Cho, F. and Uchikawa, S. (1977). Toyota production system and Kanban system: Materialization of just-in-time and respect-for-human system. *International Journal of Production Research*, *15*(6), 553–564.

Further Reading

Ayers, James B. (2001). *Handbook of Supply Chain Management*, New York, The St. Lucie Press/APICS Series on Resource Management.

Bayles, Deborah L. (2001). *E-Commerce Logistics and Fulfillment: Delivering the Goods*, Upper Saddle River, NJ, Prentice Hall.

Bloomberg, David J., LeMay, Stephen A. and Hanna, Joe B. (2002). *Logistics*, Upper Saddle River, NJ, Prentice Hall.

Christopher, Martin (1998). *Logistics and Supply Chain Management*, London, Prentice Hall/Pearson Education.

Cooper, Robin and Slagmulder, Regine (1999). *Supply Chain Development for the Lean Enterprise: Interorganizational Cost Management*, Portland, OR, FAR/Productivity Press.

Frazelle, Edward H. (2002). *World-Class Warehousing and Material Handling*, New York, McGraw-Hill.

Harvard Business Review on Managing the Value Chain (2000). Boston, MA, Harvard Business School Press.

Hopp, Wallace J. and Spearman, Mark L. (1996). *Factory Physics*, Chicago, Il, Irwin.

Kulwiec, Raymond A. (ed.) (1985). *Materials Handling Handbook*, New York, Wiley-Interscience.

Lambert, Douglas M., Stock, James R. and Ellram, Lisa M. (1998). *Fundamentals of Logistics Management*, Boston, MA, Irwin/McGraw-Hill.

Liker, J. (ed.) (1994). *Engineered in Japan*, Oxford, Oxford University Press.

Monden, Y. (1993). *Toyota Production System*, North Carolina, IIE Press.

Mulcahy, David E. (1994). *Warehouse Distribution and Operations Handbook*, New York, McGraw-Hill.

NPW Promotion Division (2005). 実践日産生産方式キーワード２５ (25 keywords of the Nissan Production Way), Nikkankogyo.

O'Leary, Daniel (2000). *Enterprise Resource Planning,* Cambridge, UK, Cambridge University Press.

Piasecki, David J. (2003). *Inventory Accuracy*, Kenosha, WI, Ops Publishing.

Poirier, Charles C. and Reiter, Stephen E. (1996). *Supply Chain Optimization*, San Francisco, CA, Berret Kohler Publishers.

Productivity Press Development Team (2002). *Pull Production for the Shop Floor*, Shopfloor Series, Portland, OR, Productivity Press.

Simchi-Levy, David, Kaminsky, Philip and Simchi-Levi, Edith (2000). *Designing and Managing the Supply Chain*, Boston, MA, Irwin/McGraw-Hill.

Suri, Rajan (1999). *Quick Response Manufacturing*, Portland, OR, Productivity Press.

Wallace, Thomas F. (2000). *Sales and Operations Planning*, Cincinnatti, OH, T.F. Wallace & Co.

Wallace, Thomas F. and Kremzar, Michael H. (2001). *ERP: Making it Happen*, New York, John Wiley & Sons.