

# EMPOWERING THE LEAN VALUE CHAIN

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*A white paper on utilizing the QAD Lean Manufacturing solution as a comprehensive system to implement and manage lean manufacturing practices within the enterprise and across the extended value chain*

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## INTRODUCTION/ABSTRACT

This white paper addresses the application of lean manufacturing techniques within the enterprise and across the supply chain, and introduces QAD's new Lean Manufacturing module as an effective and comprehensive means of achieving that goal. Sections include:

### *The Economic Imperative to Lean Manufacturing*

Detailing the changes in manufacturing and how these changes have led to increased pressures on manufacturers—specifically as it relates to reducing waste and cutting costs—and their role in driving lean manufacturing towards the center of contemporary manufacturing strategy.

### *The Rise of Lean*

Describing the development and impact of lean manufacturing as a discipline and addressing the accelerating evolution of lean from a company-based to supply chain-based practice.

### *Emergence of the Lean Value Chain*

Explaining the rationale behind applying lean techniques across the extended value chain and speaks to the barriers organizations face in making their supply chains lean.

### *QAD Lean Manufacturing module: Empowering the Lean Value Chain*

Identifies the effective requirements of a lean value chain and introduces the QAD Lean Manufacturing solution as a comprehensive means to meeting these. Provides a description and general overview of the new Lean Manufacturing module, detailing the practical implementation of Toyota Production System concepts in the areas of flow and pull systems across an extended value-stream as a way to help drive waste from the supply chain.

### *An Overview of Functionality*

Detailed overview of QAD Lean Manufacturing features, functionality and benefits, including a key-feature matrix.

### *Summary*

Summary considerations of how lean manufacturing has proved itself in the field—and where we may expect it go as it becomes more prevalent in the supply chain. Explanation of how QAD Lean solutions will help empower this transformation for manufacturers.

## THE ECONOMIC IMPERATIVE TO LEAN MANUFACTURING

The face of manufacturing has changed in the space of a decade. The advent of the Internet and ubiquitous implementation of Web-based technologies and business strategies – so integral to today’s commerce that one almost has to labor to remember what business life was like before their existence – have dramatically changed the marketplace. Local has become global. Push has become pull. Time has become real time. Monolithic enterprises have given way to extended supply chains, and the considered focus of manufacturing executives now has to expand beyond their own companies per se to include suppliers, partners and, above all, customers.

Conditioned to the speed and ease of communications in a digital world, individuals and organizations now expect round-the-clock access to track and place orders, products and services to be available on demand, and in many cases the ability to customize those products and services to their specific needs or desires.

In addition, with manufacturing becoming more and more global, suppliers are as likely to be in Shanghai or (fill in the blank) as next door. Supply chains compete against supply chains and only intense coordination provides long-term competitive advantage. Today the real cost reduction opportunities for many companies are in the linkages to suppliers and customers.

These shifts in “the rules of the game” have forced manufacturers to become more resolute and innovative in squeezing costs out of the manufacturing process. They are, without a doubt, major drivers in the growing imperative for lean manufacturing.

## THE RISE OF LEAN

In today’s accelerating, expanding and frequently volatile markets, demand can be exceedingly difficult to predict. As orders are processed through digital channels, demand changes moment by moment. In order to respond to such change – and keep the costs of responding at minimum levels – companies must have the capabilities to meet demand as it occurs.

Conventional mass production manufacturing models lack the flexibility to respond as rapidly as necessary in today’s marketplace. Push-based mass production models that evolved from a bygone era result in extended lead times, excess inventory, poor quality and a vicious cycle where high inventory translates to longer lead times and a value stream that is no longer responsive to the customer and the changing needs of the customer.

An accounting mentality of “low per piece cost” led to pursuit of volume – at the piece part level – with questionable decisions about manufacturing equipment, flows, organization, etc. taking place. Volume covered all ills – whether it be high setups, quality issues or any of a number of other problems.

Even though improved systems were developed to allow manufacturing enterprises to work around the problems of poor and disconnected flows, the core problems of mass production is that it ultimately cannot be responsive enough to customer needs.

Mass production was the only model until the Japanese, principally Taiichi Ohno and Toyota in the 1950s, decided to compete with the American automotive industry. What Ohno decided though was that Toyota could never compete on volume and there had to be a fundamental rethinking of how manufacturing was organized. Ohno decided that the key thing was to flow material to the pull of the customer based on consumption, not based on anticipation of demand in the future. The result was the Toyota Production System (TPS) – the foundation for lean thinking and lean systems in use throughout the world today.

### The Lean Manufacturing Environment

A critical common characteristic of lean organizations is the ability to understand how value is perceived by the customer. If the customer's perspective of value is not understood then it is not possible to understand what does and does not constitute waste.

For example, over-designing a car for customers is wasteful. If features are included that the customer doesn't care about, that is wasteful. If a firm manufactures piece parts and mills them to 1/10,000th when 1/1,000th would do, that is wasteful.

This is a key concept because the idea of eliminating waste from – and adding value to – all processes involved in product design, creation and delivery is at the core of lean manufacturing philosophy. While lean manufacturing environments differ according to the nature and needs of the manufacturer, they all share a number of critical elements:

- Production is done according to customer demand.
- Value is assessed from a customer perspective.
- Processes are designed for maximum flow.
- Continuous improvement procedures are integral to operations.
- Personnel are empowered to control the manufacturing processes for which they are responsible, and they have the authority to shift operations based on real-time demand.

In addition to these shared characteristics, there is another one that operates on a higher level: lean manufacturing is a philosophy, a way of life, a commitment to elimination of waste no matter where it exists in the organization. Corollary to this – and essential to competitive vigor in markets where the pressure to cut costs is constant or rising – is the idea of doing more with less: less time, less effort, less space, less money.

This philosophy means going beyond mere inventory reduction—it means identifying and eliminating waste in time, materials and energy (both power consumption and human effort). As waste can exist in any enterprise process or element (e.g., setups, fixturing, processing, assembly, maintenance, inventory, asset utilization, packaging, transportation, manual operations, redundant operations, paperwork, quality), it means continuing vigilance, assessment and positive correction—the continuous improvement of kaizen. Kaizen applies to all departments within the lean enterprise—finance, IT and human resources as well as manufacturing and logistics.

Since most waste in a manufacturing enterprise eventually ends up as excess inventory, the benefits of stripping waste out of all processes are huge. They include:

- Shorter lead times
- Higher throughput
- Reduced costs
- Improved quality
- Better communications
- More efficient collaboration
- Tight integration of production and demand

Lean manufacturing pioneers initially were focused on the “achievement of lean” within a company’s four walls. But the digitally driven emergence of collaborative commerce—the emergence of value chains as the principal competitive structure within the global marketplace—has demanded that lean practitioners take a broader view of their discipline. And it requires the realization that IT, far from being superfluous to lean operations as many of its early evangelists claimed, is increasingly important for lean operations throughout the extended value stream.

## **EMERGENCE OF THE LEAN SUPPLY CHAIN/EXTENDED VALUE STREAM**

“Manufacturers implementing lean manufacturing processes often think simplicity of process means excluding the use of information technology,” says Michael Burkett, director of research at Boston-based industry analyst AMR Research (AMR). “Wrong. Internet-based applications provide flexibility and are vital as lean manufacturing expands to include design and the supply chain.”

It is no longer debatable that lean practices need to expand and focus on the extended value stream.

Take, for example, the automotive supply chain. The Automotive Industries Action Group (AIAG) estimates that a change in demand is not recognized by the next tier of the supply chain for a week or more. During that week, an enterprise receives and processes customer orders, develops manufacturing requirements and then generates orders to the next supplier down the supply chain. These are all internal processes. With six tiers typically in the automotive supply chain, it may take a minimum of six weeks for automakers to communicate the requirement for parts needed to the lowest levels of the supply chain. Little wonder that one analyst has pegged excess automotive inventory at \$700 billion annually!

For manufacturers, Enterprise Resource Planning (ERP) systems have traditionally been used to cope with waste, poor flows, large batches and other manufacturing (or supply chain) problems. But factors such as increasingly uncertain demand, more complex variations in product mix and growing variability in customer ordering patterns are forcing manufacturers to rethink traditional execution systems. New thinking is that planning systems provide long-range visibility and lean execution systems provide more direct and responsive linkage to real customer demand.

At a high level, this reconsideration of traditional systems can be seen as providing momentum to lean initiatives; at a tactical level among lean practitioners, it's driving the move of lean manufacturing beyond the enterprise to the supply chain/extended value stream.

To implement lean techniques across the value stream, communication must reach beyond the company to the extended enterprise of suppliers, partners and customers. When manufacturers throughout a value chain achieve transparency – 100 percent connectivity – the value chain has the potential to become dramatically more responsive and agile.

Until recently, this goal seemed to be just out of reach. Electronic data interchange (EDI) appeared to be the most cost-effective means of communicating demand and replenishment information, as well as integrating large volumes of customer and supplier data between links in the chain. In practice, however, EDI remained the province of very large manufacturing enterprises, proving neither affordable nor practical for smaller manufacturers in the lower tiers.

The development of Web-based communications has addressed that problem, making it possible for manufacturers of all sizes, geographic locations and industrial sectors to connect and communicate quickly and cost-effectively. Coupling electronic kanbans with Web-based inventory applications and lean manufacturing operations makes the desired communications and collaborative structures viable, fast and extraordinarily efficient.

Nonetheless some barriers to the lean supply chain have proven more difficult to hurdle:

1. Lean execution systems are not enough. Lean planning activities are needed between high-level planning and lean execution to address issues like long-range capacity management, and the plant and cell design necessary to support changing takt times for effective leveling.
2. Sophisticated mathematical functionality is a necessity for effective calculations used in takt time, leveling, every-part-every interval (EPEI).
3. Commonly used tools like Excel spreadsheets are inadequate for effectively leveraging the granular data resident in higher-level planning systems.

The point is that, however religiously implemented and adhered to, lean manufacturing execution cannot function effectively – internally or across the extended value stream – without a complimentary planning system for determining medium- and long-term supplier schedules, and a system for providing basic data on customer demand for critical lean calculations like takt time and loop sizing.

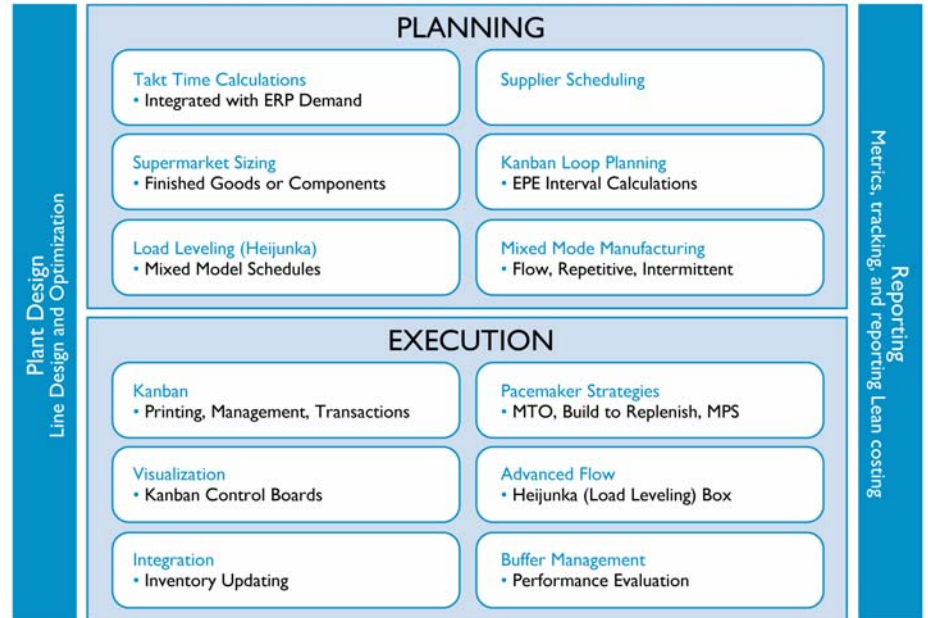
What manufacturers really need is a system integrating ERP's relatively long-term outputs with the immediacy of an execution system inaugurated by kanbans. Such a system would give an enterprise the best views of the external marketplace, extended value chain, and internal production and inventory resources available to commit in order to responsively meet market requirements. Such a system is now at hand.

## **THE QAD LEAN MANUFACTURING MODULE: EMPOWERING THE LEAN SUPPLY CHAIN/EXTENDED VALUE STREAM**

Eliminating waste and reducing inventory can quickly enable a manufacturer to have more responsive manufacturing operations, shorter lead times, better customer service, improved cash flow and enhanced profitability. To do this effectively requires:

1. Immediate, simple, direct statements about customer demand and the replenishment of that demand throughout the supply chain/extended value stream.
2. Fast, effective, near real-time communications to complement requirements planning, replenishment and inventory management systems while facilitating collaboration.
3. Going beyond the implementation of lean manufacturing to the implementation of lean techniques and operations across the extended value stream.

The QAD Lean Manufacturing module meets all three requirements.



Lean manufacturing philosophy is reflected throughout the QAD Lean module. The QAD Lean Manufacturing solution trims time and cost from every step in the customer demand and material replenishment process; dynamically resizes kanban loops based on current customer demand, forecast or build schedules; and includes 100 percent partner connectivity and financial settlement as part of an all-encompassing approach to lean manufacturing and supply chain management. By offering flexible choices in each of these arenas, QAD makes it easy for manufacturers to share information to meet the needs of a wide range of customers and trading partners.

QAD Lean Manufacturing is fully integrated with MFG/PRO and built to focus solely on lean manufacturing and supply chain execution. By formalizing the pull-through process in manufacturing, QAD Lean Manufacturing empowers manufacturers to drive down inventory while maintaining or improving high levels of customer satisfaction.

### How the Module Works

Based on takt time – the drum beat as established by the customer – QAD Lean Manufacturing combines both lean planning (takt time, average daily demand calculations, order intervals or EPEI computations, safety stock and buffer planning, as well as kanban calculations) and lean execution techniques (kanban, demand pull, flow, etc.).

The result is a system that highlights changes in demand and supply, enabling real-time monitoring of customer demand, responding to and triggering out-of-condition alerts, and adjusting lean manufacturing and supply chain parameters on the fly as changes occur. The module calculates and dynamically resizes kanban loops based on actual and historical orders; it determines manufacturing lot sizes, production timings, buffer stock and centralized inventory (i.e. “supermarket”) levels.

*As a planning system*, QAD Lean Manufacturing inserts another series of planning processes between the high-level planning processes of ERP and Lean execution. This assures that all planning calculations are based on consistent enterprise data. The solution allows manufacturers to respond to fluctuating customer demand by performing analysis and monitoring of lean parameters based on actual demand, future requirements and the state of supply chain readiness.

*As an execution system*, QAD Lean Manufacturing sends kanban signals to downstream operations – within the plant or to suppliers within the value stream. Kanban signals or Web-based visualization make accurate inventory replenishment information immediately available, thereby:

- Reducing information lead times
- Eliminating waste in the flow of materials from suppliers to customers
- Synchronizing internal manufacturing processes with the external value chain

Such dynamic planning and execution directly controls the inventory buffers suppliers carry to cover delays in communicating demand from customers to suppliers and vice versa. QAD Lean Manufacturing helps makes these buffers lean and helps eliminate inventory throughout the supply chain rather than merely displacing that inventory from one part of the chain to another.

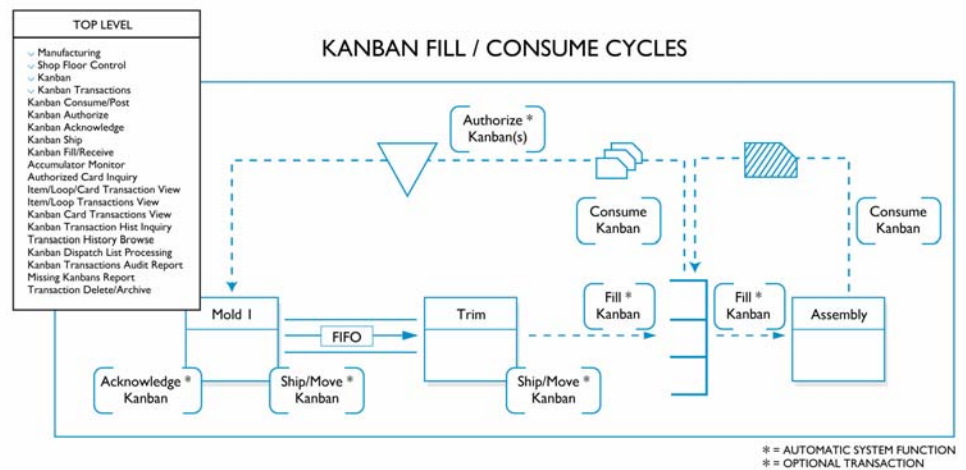
## AN OVERVIEW OF FUNCTIONALITY

The QAD Lean module has a very important difference that distinguishes it from homegrown solutions – it is fully integrated with QAD MFG/PRO. This integration minimizes redundant data entry, ensures consistency in the analysis of lean metrics with the demand and replenishment data contained in the ERP system, and appreciably speeds the execution of customer demand on the production floor. The module incorporates advanced flow and lean processing methods, including all the analysis tools and recalculations already used by lean practitioners with internally developed spreadsheets running on desktop computers.

The QAD Lean module consists of modeling software to evaluate a supply chain, analytics for kanban sizing and level loading, and a kanban transaction system to electronically track the replenishment cycle from suppliers – on the factory floor. It also includes QAD’s Kanban Visualization, a computer simulation of a kanban board for displaying the state of any given kanban loop(s).

Also included in the QAD Lean module advanced functionality are:

- Advanced logic for every-part-every-interval (EPEI) calculations
- Workbench simulation capabilities for:
  - Sizing inventory buffers
  - Determining the number of kanbans
  - Determining the kanban quantities for each process (i.e., internal) or supplier (i.e., external) loop
  - Analyzing product mix
  - Developing leveled schedules at the pacemaker process
- Enhanced lean manufacturing techniques, including:
  - Average demand calculations
  - Advanced methods for establishing inventory buffer quantities (e.g., dynamic safety stock calculations)
- Inventory buffer (i.e., supermarket) management functionality based on average demand analysis to:
  - Determine appropriate initial quantities
  - Evaluate historical and projected buffer performance
  - Make adjustments as needed
- The ability to communicate kanban status throughout the supply chain
- Enhanced kanban transaction processing, including multiple states for individual cards and the ability to accumulate cards to authorize production based on order quantity or specified time intervals



While the features incorporated in QAD Lean Manufacturing are too numerous to list in a document of this type, a key-feature matrix is provided below:

Feature	Definition	Functionality
Load-leveling	Balancing the volume and mix of production over a fixed period of time to enable production to meet customer demand while avoiding batching. Involves smoothing and sequencing production evenly and in a repetitive pattern. Also called "Heijunka."	The QAD Lean Manufacturing module includes industry-leading load-leveling functionality. Performing major functions for your pacemaker processes including volume of parts, mix of various items, suggested daily level schedule by shift for each item based on process volume, mix, pitch, EPEI and more.
Supermarket management	A supermarket is a tightly managed amount of inventory dedicated to pull operations. A supermarket can exist anywhere in the supply chain and can contain finished items or work-in-process.	The QAD Lean module calculates the size of supermarkets.
Average demand calculations	Average demand is calculated from various combinations of historical and projected future demand data.	The QAD Lean module provides multiple templates for average demand calculations. Users can select the appropriate template when the module calculates supermarket size, safety stock size, quantity of kanbans in a loop and other lean parameters.
Safety stock calculations	Safety stock is calculated to ensure appropriate inventory for meeting real-time demand.	The QAD Lean module provides multiple ways of specifying safety stock – by quantity, by desired number of days with average demand calculations – or allows acceptance of an automatic calculation based on desired service level and calculated demand variability (standard deviation), or peak demand during a user-specified period.

EPEI calculations	Every-part-every-interval calculations help determine the manufacturing lot size and supermarket quantities for each part produced in a particular manufacturing process, as well as the number of kanbans in a replenishment loop.	The QAD Lean module EPEI calculation results in the smallest lot size possible for production to meet anticipated demand without exceeding the capacity of any work center. It can be calculated while simulating kanban loops or with a standalone, menu-driven program. Because the QAD Lean module dynamically recalculates kanban loops, the system can winnow buffer stock to the absolute minimum based on latest demand. Such calculation is not practical manually.
Takt time calculation	Takt time represents the customer demand rate and is used to synchronize production with sales rates.	The QAD Lean module uses level load calculations to determine the quantity of product to be run each day based on the available time for the pacemaker (i.e., the process that sets the pace for the entire supply chain) and takt time.
Workbenches	Workbenches – including Sizing, Leveling, and Buffer Evaluation Workbenches – use demand data that exists in the ERP system to run simulations; the results can become inputs to calculations made in the QAD Lean module.	Several workbenches are available with the QAD Lean module, including Supermarket, Historical Buffer Evaluation, Kanban and Level Mix.
Kanban transactions	Kanban transactions provide the ability to post receipts and inventory movement transactions in response to filled kanbans.	The QAD Lean module adds two processing options to the basic MFG/PRO eB2 kanban transaction functionality: individual states for each kanban card and accumulators. Individual states are menu-level programs that track kanban post/consume, authorize, acknowledge, ship and fill/receive actions.

Kanban Visualization	This computer simulation of a kanban board displays the state of any given kanban loop or loops.	Kanban Visualization provides customers and suppliers with visibility into the entire supply chain through faster turnaround of planning information, supplier capacity, inventory movement, etc. It helps enterprises see beyond electronic shipping schedules to reduce inventory levels.
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## SUMMARY

That lean manufacturing has moved from the fringe of manufacturing thought towards the strategic center is unquestioned.

“I am convinced that lean manufacturing is here to stay and continues to prove its worth,” says David Caruso, senior vice president and director of research at AMR. “Throughout [the recent economic downturn], the best companies have not stood still. And it’s clear that manufacturers see their lean initiatives as among the key enablers of the cost reductions that created recent profitability.”

With the QAD Lean Manufacturing solution, the advantages that have positioned lean manufacturing as a key profit enabler for manufacturers are now ready to reach substantially greater heights. If individual companies have maintained or extended profitability and competitiveness through lean techniques, imagine the advantages they will reap when their entire supply chain leverages these powerful tools for benefit.

The QAD Lean Manufacturing solution supports inventory management, waste elimination and streamlining processes throughout the extended value chain. Its ability to provide a complete lean manufacturing tool across the supply chain—supporting all inventory replenishment methods, consignment inventory, warehouse management, shipping and receiving, customer and supplier performance monitoring, shop floor activity, process monitoring, business intelligence, and financial settlement—provides supply chains with a way of doing business that delivers competitive advantage. In today’s dynamic and increasingly challenging markets, such an advantage can mean the difference between surviving and thriving.

By eliminating waste, alerting participants of demand in the medium best suited to their needs, reducing the time required for manufacturing processes, presenting complex information in forms that are easy to access and understand, facilitating collaboration, and enabling 100 percent connectivity across the extended value stream, QAD Lean Manufacturing helps deliver the bottom line benefits lean manufacturing was devised to produce.

Lean is about doing. By enabling supply chains to execute lean techniques from end-to-end, the QAD Lean Manufacturing solution will enable manufacturing companies to do more – more efficiently, more quickly, more precisely and more profitably than heretofore imagined. And in doing so, it will play its part in creating the future.

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