Perfecting the

One approach to building an ideal high-mix, sequenced manufacturing supply channel

BY JIM PRICE

In an ideal high-mix, sequenced manufacturing world, the exact number of correct supplies would arrive at the correct place on time to create high-quality products that satisfy customers' requirements. In that ideal world, supplies would originate at the appropriate upstream tier of the supply channel and flow unimpeded through all downstream stages to the Points of Use (POU) without delay. There would be no need to store inventory at any point along the supply channel, and supplies would flow naturally in "like duration" stages from their sources to customers' specific POUs.

Our objective in the Just in Time (JIT) re-engineering of a high-mix manufacturer's supply channel is to achieve this ideal flow as closely as possible. To achieve this objective, the entire manufacturing enterprise — manufacturing, production administrative support and supply support systems — must be a single, interconnected, coupled system. The goal is to optimize the whole, not a system subcomponent.

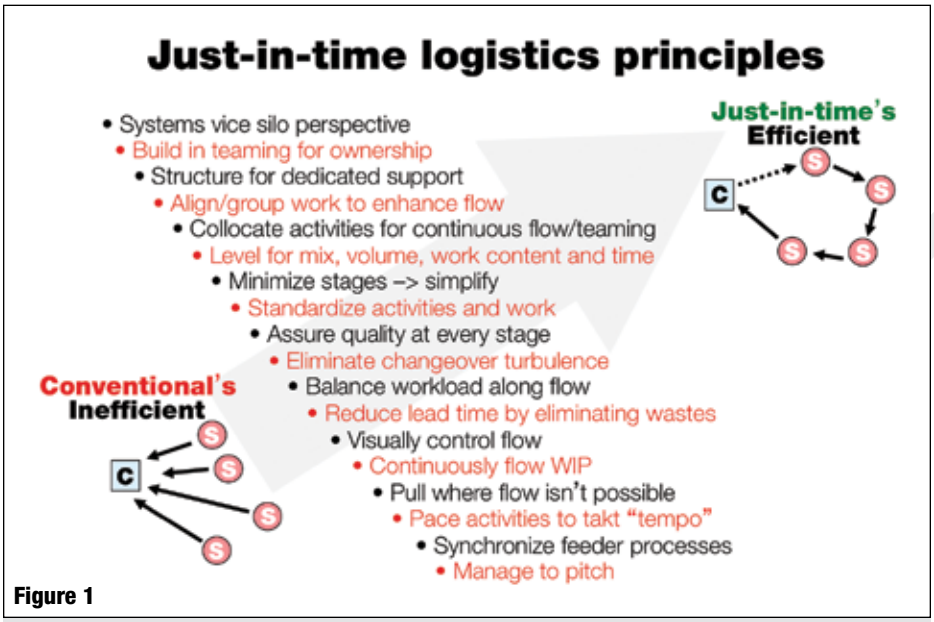

Figure 1

As reflected in Figure 1, Toyota's JIT flow principles refer to all aspects of the enterprise and must be translated and integrated into every component of the focus enterprise.

In order to effectively support high-mix manufacturing production, production sequencing must be "smoothed" or "normalized" (have low variation and be consistent, repeatable, reliable, etc.) to the point that all of its support systems can also be normalized. As such, the variability in the replenishment pull signals that are sent to support systems is significantly reduced and normalized.

manufacturing flow

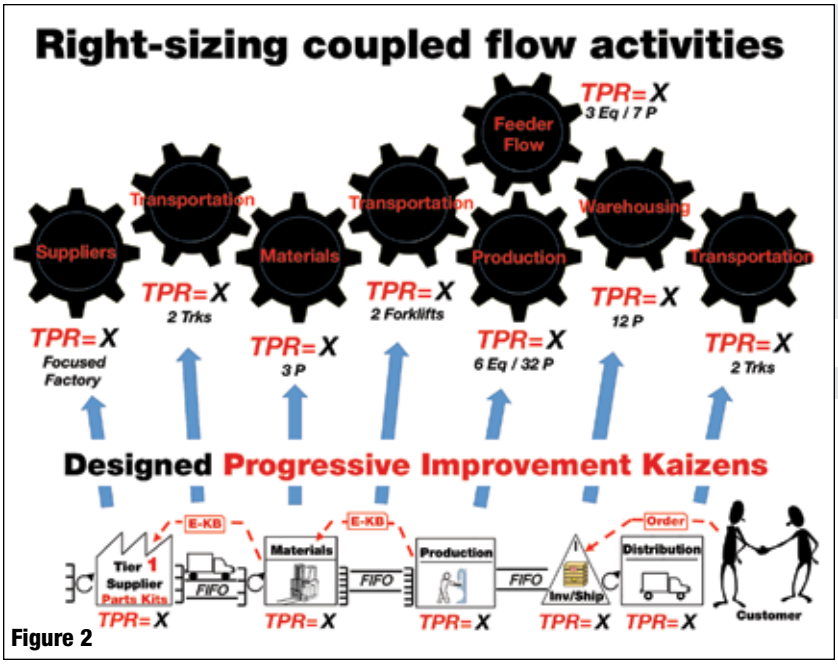

Figure 2

As reflected in Figure 2, with normalized production demands, production value streams can be streamlined, right-sized (designed for equal Work in Process (WIP) throughput rates (TPR)) and coupled as a team of activities, all working at the same end customer designated takt or demand rate. This consistent indexing pace enables WIP to index flow through progressive stages from start to finish.

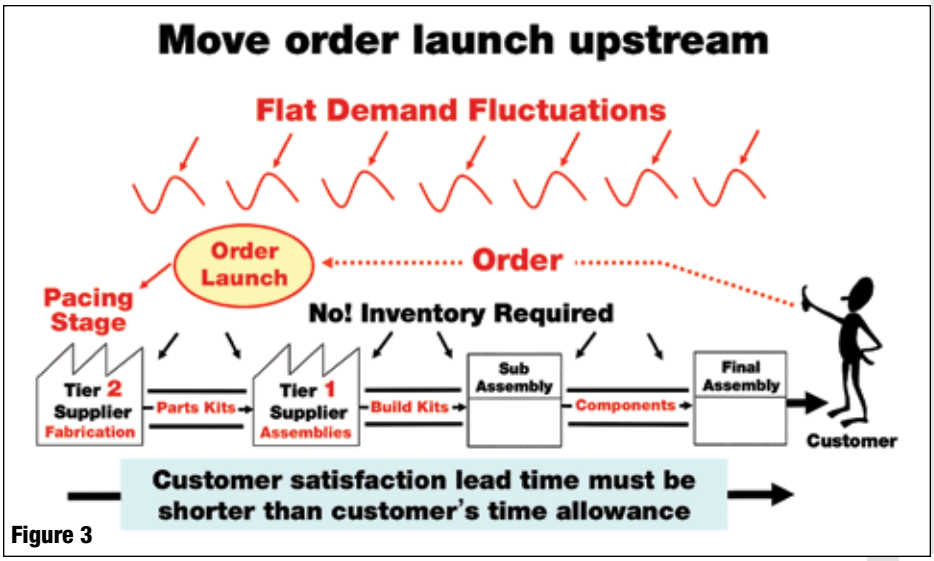

Figure 3

As reflected in Figure 3, waste and delay can be eliminated from the production value stream to increase the velocity of WIP flow. The point at which customer orders are launched, known as the "pacemaker process," can be moved further upstream. This is true only as long as the product's make-to-order period (manufacturing lead time, or throughput time (TPT)) does not exceed the customer's time allowance to deliver products. As the point-of-order launch is moved upstream, the magnitude of demand fluctuations is greatly reduced, and product WIP can flow downstream of the pacemaker in a First-In, First-Out (FIFO) sequential manner. Therefore, the need for downstream inventory can be all but eliminated.

Assuming that production flow is normalized, analysis must define a Plan for Every Part (PFEP), encompassing all supplies, materials and tooling necessary for the enterprise to progressively and efficiently add value at every POU along the production flow.

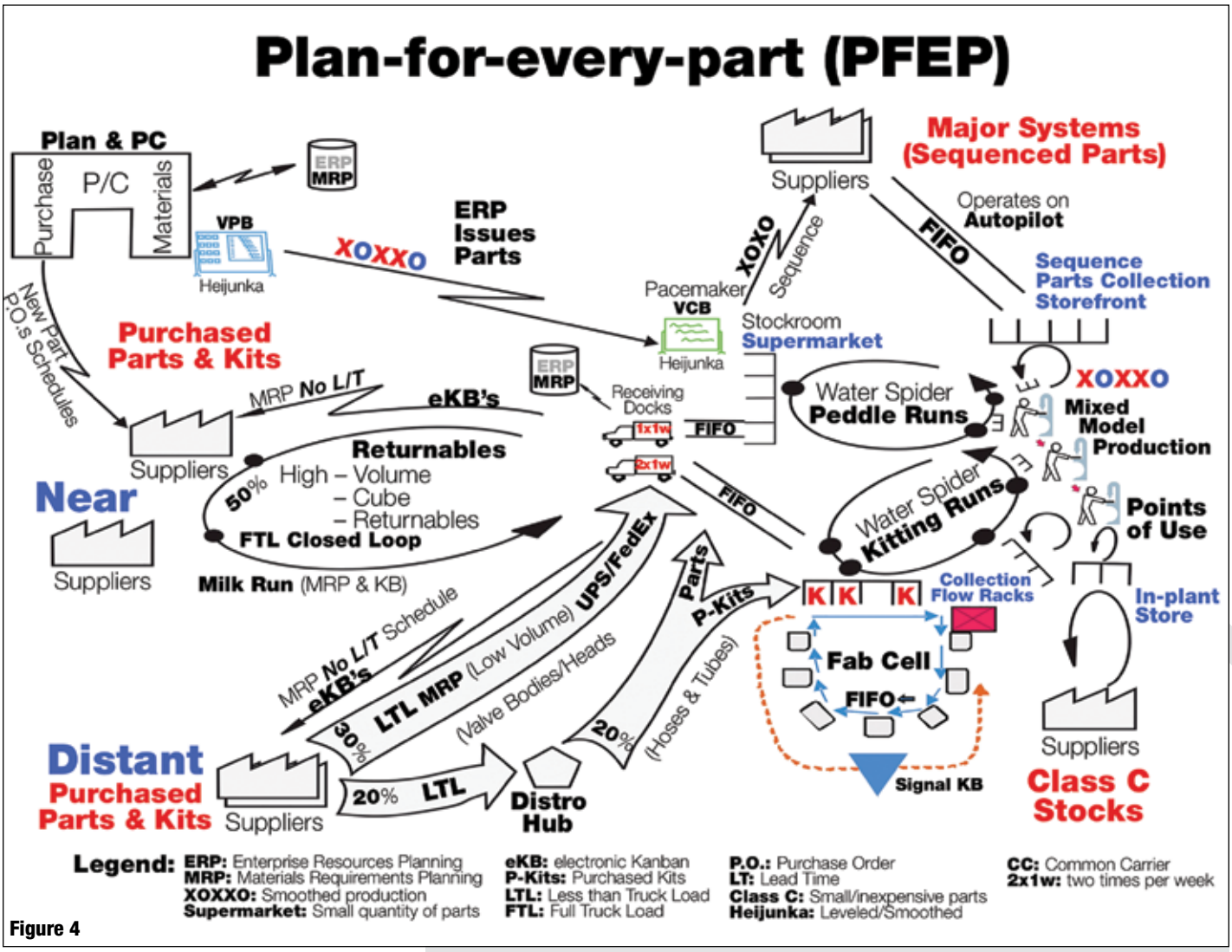

Figure 4

As reflected in Figure 4, the focus of channeling supplies from their originating sources to needing POUs must involve providing all of the parts, supplies, tools, etc., required to provide POU operators with a Complete Task Completion Kit. Accomplishing this requires orchestrating the provision of all supplies and equipment at the exact spot and exact time.

Because every manufacturing process is different, the paths of the flow and the mechanisms, such as which type of Kanban (KB) pull system will be used, will also be different. Hence, it requires a tailored JIT replenishment solution for every similar group of parts, supplies and tooling items. The flow from these differing JIT replenishment solutions must blend and merge at a point close to the POU. There, they can be combined into the required Complete Task Completion Kit, which is then sequenced to the POU at the correct time to enable product WIP to flow smoothly.

Figure 5 reflects the integration of all of the components discussed above to enable Complete Task Completion Kits (Task Card (T/C)) to be dynamically created from numerous staging points, feeder cells, MRO cribs, tooling cribs, receiving dock staging spaces and supermarkets. Specific kits can then be cascade delivered to sequential groups of POUs just-in-time. A Water Spider simply collects the staged pick lists for all of his supported POUs from the VSB top row and then accomplishes a "milk run" pick tour, building the required Complete Task Completion Kits. Then the cascade delivers them sequentially to the correct POU.

Once the receiving dock/storage point Complete Task Completion Kitting Delivery System is in place, external suppliers can be recruited to flow supplies and parts from their external operations to the enterprise's receiving docks just-in-time.

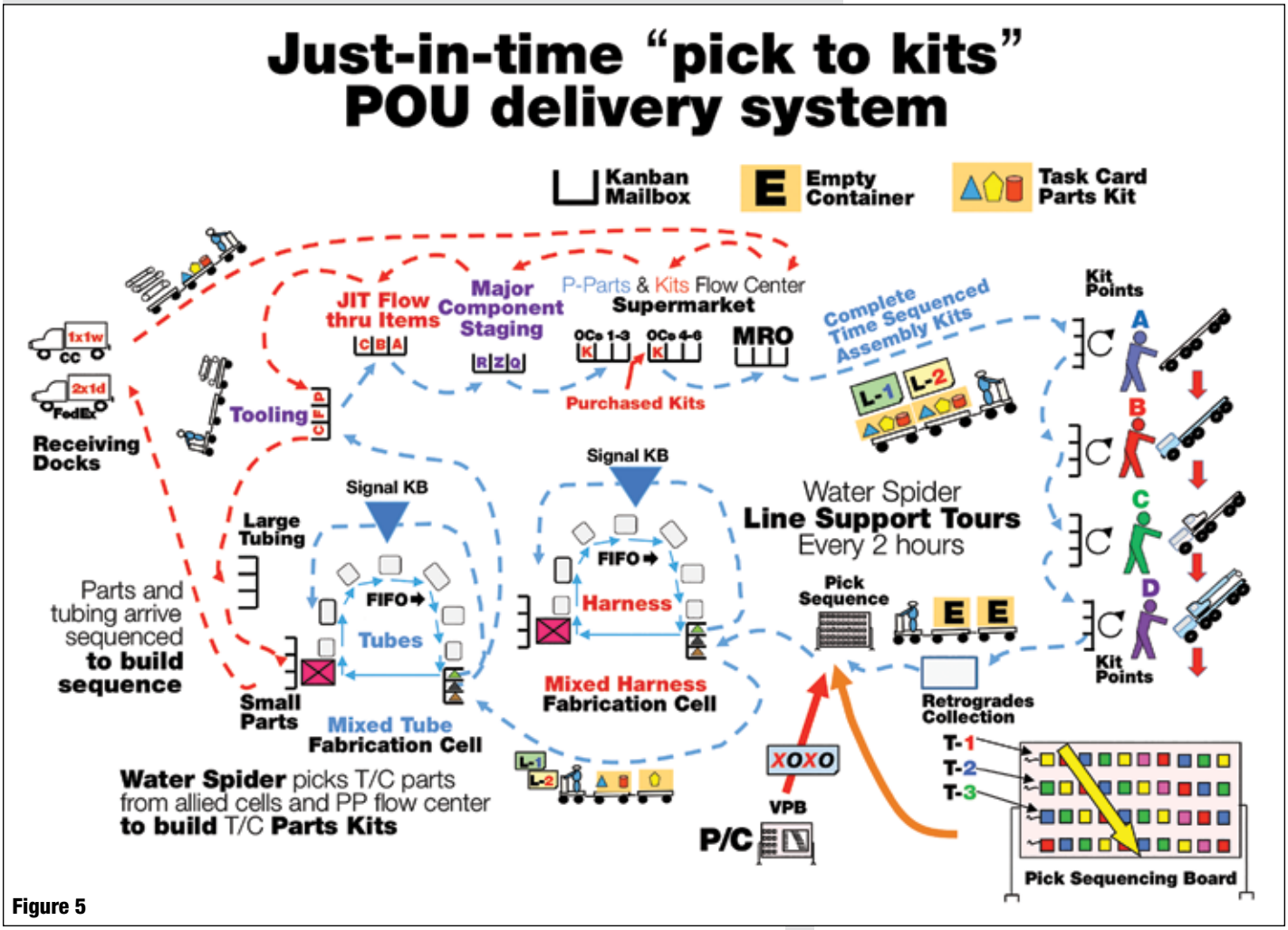

Figure 5

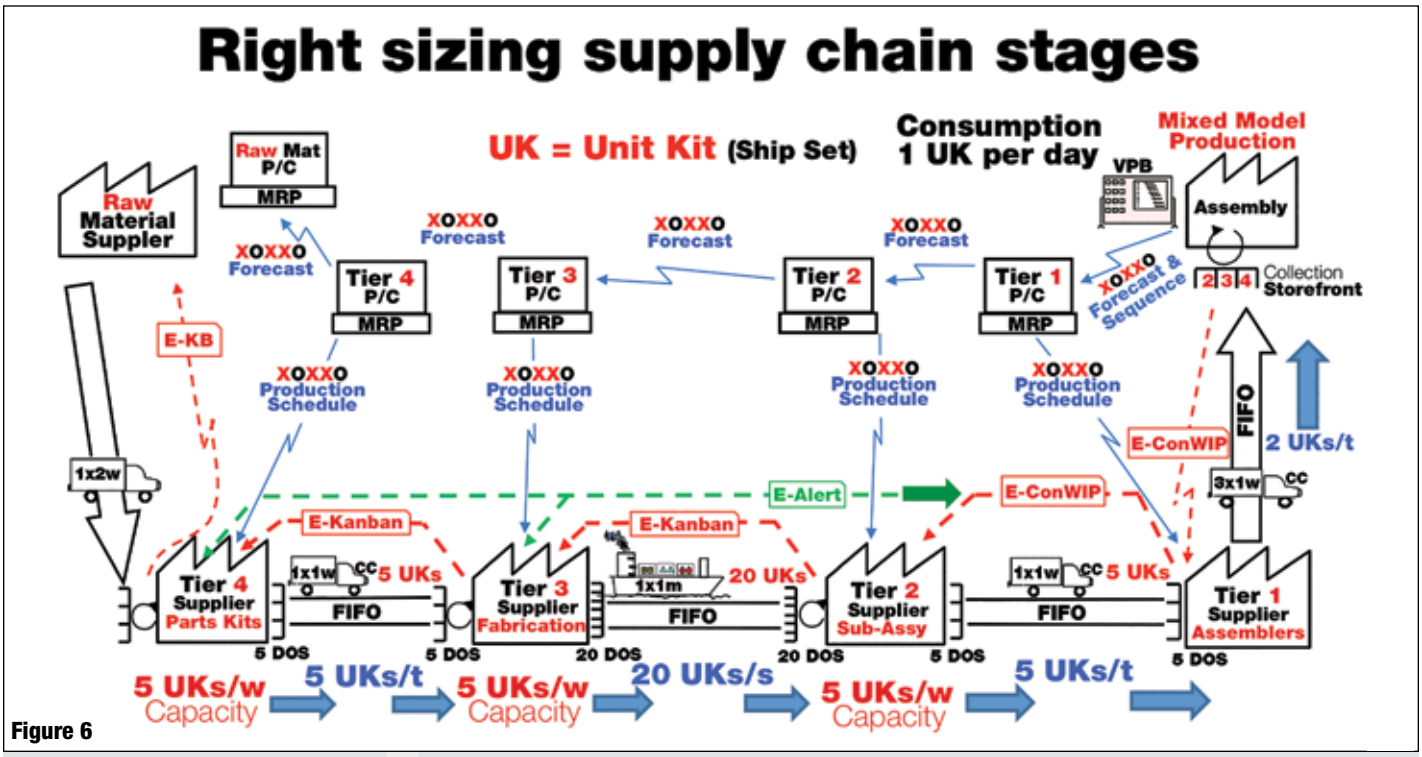

Figure 6

In Figure 6, the concept of enabling WIP flow by normalizing all internal activities to operate at the customer's takt tempo also works between the enterprise and its external suppliers. However, as external teaming suppliers are integrated into the enterprise's supply channel flow system, additional tools must be employed to mitigate the variability that naturally exists between geographically separated activities. Because transport of supplies and parts normally occurs in infrequent intervals and in quantities too large to be immediately consumed, buffers must be designed to absorb this materials relocation variability. This enables suppliers and downstream consumers to consistently operate in heijunka (in a leveled and balanced manner) at the customer's takt tempo.

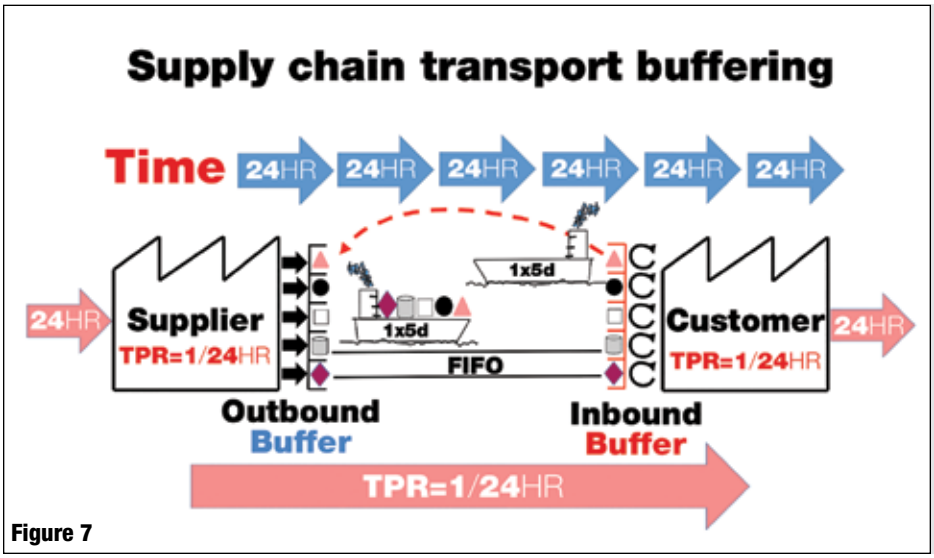

Figure 7

One of these devices is reflected in Figure 7 as size-designed buffers both upstream and downstream of the transportation lane between a supplier and its customer. These buffers serve to smooth the variation between the activities by enabling both the supplier and the customer to operate at the customer demand takt tempo, while the transporter can transport several periods of supply over a single, less frequent trip. For example, if the transporter can carry five days of supply, then he needs only make the trip every five working days. This variation must be buffered by collecting and holding five days of supplier output in an outbound collection buffer, while collecting and

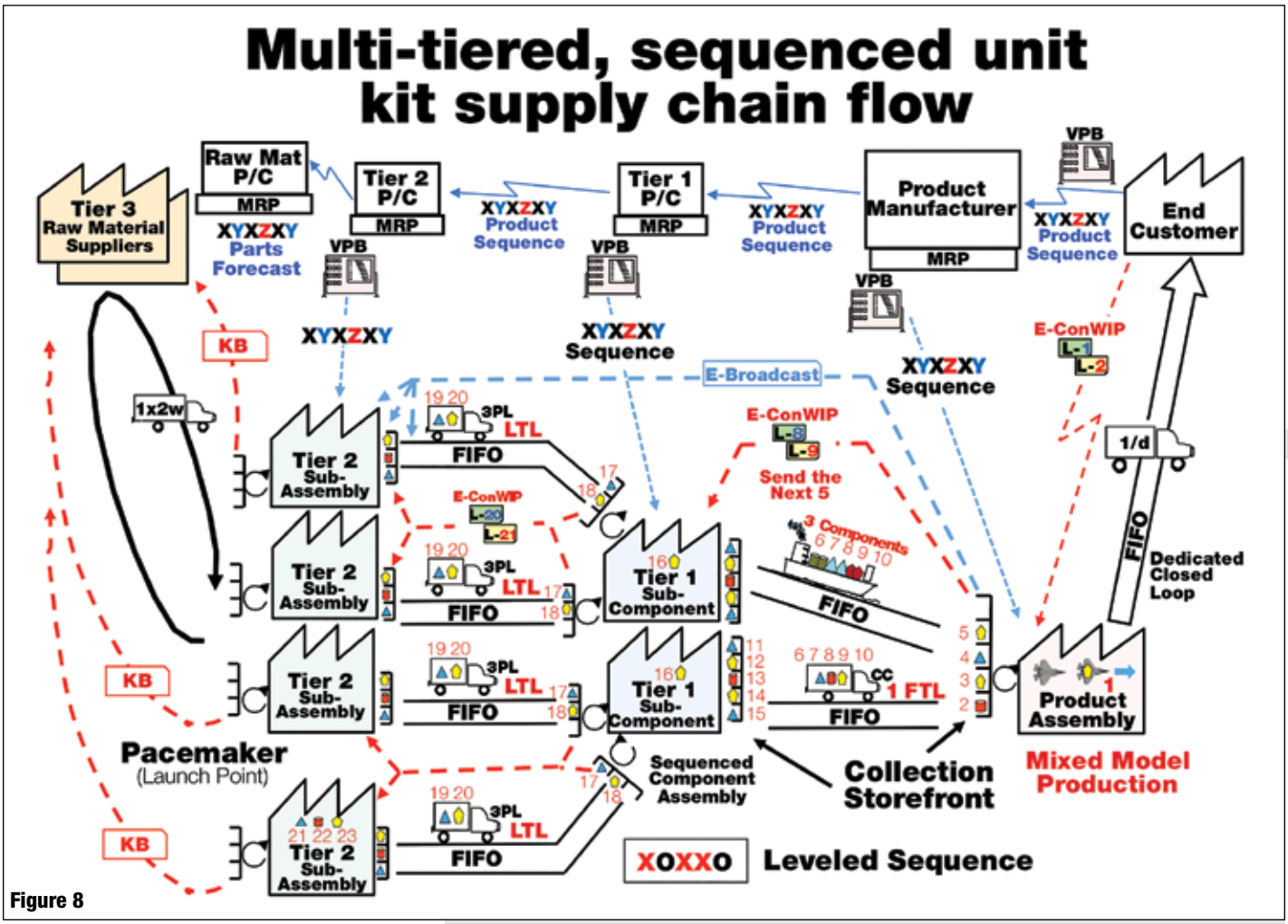

Figure 8

dispensing from a five-day supply inbound buffer at the customer end. This eliminates the large variation caused by the transport of supplies by designing the throughput rate of the transport segment to equal the customer takt-dictated TPR operating within both the supplier and customer. Thus, the entire segment of this manufacturing supply channel system is in heijunka.

Transformation to the indexing flow system described in Figure 6 enables the flow of supplies in finished product size packages and in a high-mix ideal FIFO sequence, without requiring inventory storage at progressive stages.

This, in turn, empowers launching specific supply items at upstream supplier tiers targeted for specific multi-variant products in the end customer's manufacturing flow. As reflected in Figure 8, moving the order launch point upstream to a higher tier supplier means that little or no supplies need to be held in inventory downstream of the pacemaker stage. Therefore, the pull mechanism, defined as Constant Work in Progress (ConWIP), will pull the next order in sequence and enable the customer to flow its production WIP in a make-to-order FIFO manner. Launching the creation of supplies and parts for a specific customer product means these items must flow FIFO to the end user's POU in order to arrive Just in Time.

Financially, this means that suppliers will automatically invoice for supplies drawn by pull signals and authorized through blanket purchase agreements.

Figure 8 expands our description of an ideal high-variety supply channel flow to include orchestrating the FIFO flow of supplies from multiple suppliers so that all of the supplies and parts necessary at a high-mix manufacturing POU arrive at the customer's receiving dock JIT. This upper-tier supplier to customer POU is possible because these JIT-arriving supplies are conveyed from the receiving dock directly to the POU, as reflected in Figure 5, just-in-time and are ready for immediate use.

Does the ideal supply channel design described in this story satisfy the majority of Toyota's JIT flow principles reflected in Figure 1? **Yes, including these benefits:**

Flow operates as a single integrated system.	Buffering the time lapse over transport links right-sizes flow between extended system activities.	Offset early launching of supplier-provided subassemblies unit kits that directly tracks the end user's production sequence requirements.
Every component of the enterprise system owns its segment.	Operating each activity and supply tier at the same customer product-sized work unit "tempo"eliminates need for flow inventory.	Visual system management devices orchestrate flow.
Right-sizing activities equals standardizing, in terms of time and work.	Pulling the next increment of both WIP and supplies as capacity becomes available indexes and synchronizes the entire high-mix manufacturing system.	Supply transport links and internal materials movement are pulled, right-sized, standardized, repetitive and reliable.
The system communicates near exact demands, eliminating the need to overproduce.	End customer must sustain planned production sequence and timing, because supplier-contributed items are being tailored to specific end products early.	Disruptions are discovered and corrected immediately.
Work is leveled, which enables right-sizing capacity within the enterprise and its suppliers.	Pulling product work units (or ship sets) from upper-tier suppliers eliminates the need for inventory downstream and enables consistent indexing flow.	The enterprise system runs on autopilot, requiring little management.

Transformation toward this ideal high-mix sequenced supply chain flow model includes obvious and exponentially valuable business benefits and is well within the capabilities of most high-variety product manufacturers. It's good business to use this framework to launch toward JIT enterprise flow.

Jim Price is president of the AME Southeast Region Board of Directors and executive director of the JIT Enterprise Institute.