ELIMINATE 7 WASTES FROM YOUR SUPPLY CHAIN
with Real-Time Asset Management Solutions from Zebra

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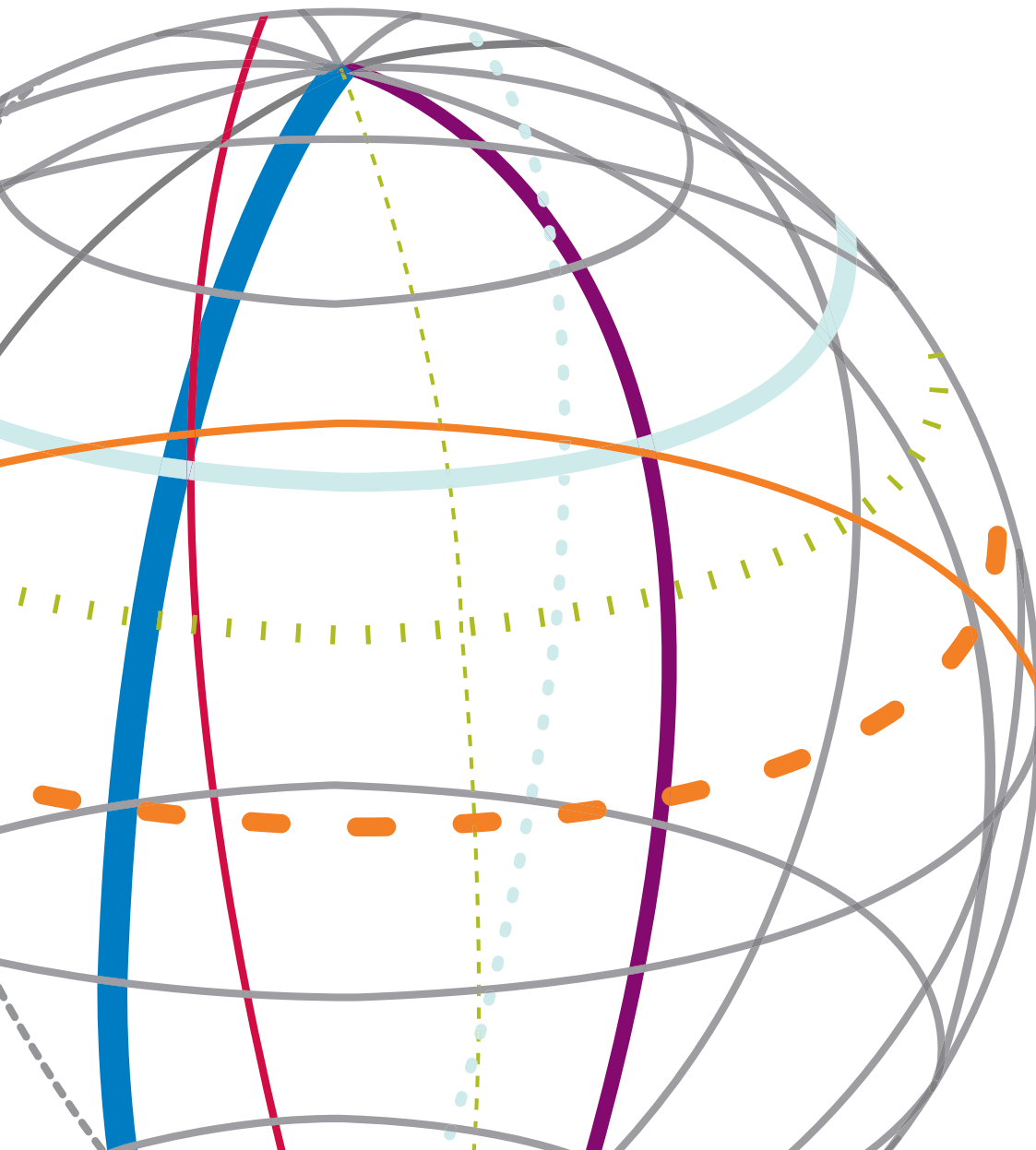
EXECUTIVE SUMMARY

In difficult economic times, lean thinking strikes a chord for manufacturers as it promises to reduce costs, improve quality and transform the bottom line, by eliminating waste in every area of the value stream, including factory management and supplier networks. Its goal is to eliminate non-value added processing from the customers' perspective, enabling less inventory, less space,less resource, less time and less cost to produce more – and all highly responsive to customer demand.

This white paper examines the impact of leveraging proven lean principles supported by Real-time Asset Management Solutions from Zebra Technologies. We will identify the seven wastes of manufacturing and how Real-time Asset Management Solutions can eradicate these wastes. You will also learn first hand how customers eliminated waste and benefited from these solutions.

THE SEVEN WASTES IN MANUFACTURING

1. **Over-production**—producing more than and/or ahead of demand. !e result of producing to speculative (forecast) demand or supposed economic batches, it is visible as excessive, time consuming and costly material stores.

2. **Waiting**—whether for the previous, current or next step in the process, the result is wasted worker time. !e goal is to maximise the utilisation and/or efficiency of operatives first and machines second.

3. **Transportation**—unnecessary transport of materials, WIP (work in progress) and #nished goods adds zero value to the product. Instead of improving transportation processes and systems, lean thinking first favours minimizing or eliminating them.

4. **Non-value added processing**—doing more work than is necessary, according to the 'value' principle – often due to poor plant layout or misguided attempts to recover expensive machinery costs. Lean essentially advocates using simpler, lower cost tools, cell manufacturing and/or combining steps, where possible.

5. **Unnecessary motion**—relating to people bending, stretching or walking too far, due primarily to the inappropriate location (and potentially also design) of tools, parts inventories and fixtures. Instead of simply automating wasted motion, lean requires that the operations themselves be improved.

6. **Excess inventory**—specifically referring to WIP between operations and purchased parts within the supply chain, frequently resulting from overproduction, usually due to excessively large batch manufacturing or processes with long cycle times – leading in turn to cost and clutter. !is waste also creates additional waste in the form of increased lead-times, excessive floor space requirements, extra handling, high interest charges, avoidable people movement and paperwork and, again, the associated costs.

7. **Defects**—producing defective parts or products results in rework and scrap and invariably adds significantly to manufacturing costs. Lean focuses on preventing the occurrence of defects, rather than improving the processes around finding and repairing them.

Lean manufacturing is about the obsessive elimination of waste – waste being defined by lean practitioners as what customers would perceive as processes and actions that don't add 'value', and for which they don't want to pay. Given the current difficult conditions for much of manufacturing in the developed world, lean is also commonly associated with getting more from less. But for the tightest definition, go to the US National Institute of Standards and Technology (NIST) Manufacturing Extension Partnership (MEP), which describes lean as: "A systematic approach to identifying and eliminating waste through continuous improvement, flowing the product at the pull of the customer in pursuit of perfection."

Succinct, yes, but useful too because implicit in that sentence is a clear warning for lean manufacturing wannabes to avoid cherry picking lean initiatives and methodologies – such as simply setting up kanban replenishment, focusing on reducing set-up times, or doing the workplace 5Ss (sort, set in order, shine,

standardize and sustain) somewhere in production or a warehouse. Instead, this definition of lean manufacturing leads instantly to the strategic, top down view, as enshrined in lean's five governing principles.

First, deliver value with, as above, the customer at front of mind. Second, identify the value stream (by value stream mapping all the stages of production, warehousing and ultimately the entire business). Third, make the value flow, with a goal (mostly unreachable) of single piece flow, by moving from the current state to a chosen future state – and remembering, crucially, that information also needs to flow. Fourth, make-to-order, meaning only make or do anything when you need to – using, for example, JIT (just in time) principles. And fifth, strive for (almost unattainable) perfection, using the methodologies and tools for both continuous and blitz (kaizen) improvements. Underpinning all of that thinking is removal of the seven prevalent wastes of lean manufacturing – those aspects that, again, fail to add value..

ADDRESSING WASTE IN THE REAL WORLD

Lean thinking is pragmatic. For example, although lean methodology drives towards zero inventory, zero waiting, rapid changeovers, zero duplication and so on, its practitioners recognise that much of production and distribution necessarily involves some batch, and even forecast, processes. They also understand that commercial pressures, often beyond a manufacturer's direct control, influence purchasing and stocking strategies.

Thus, whether those issues concern material availability and pricing, or customer service strategies dictated by competition, there is scope in lean thinking for some apparent waste, particularly in the areas of overproduction and transportation. However, while some waste might be justifiable, lean's principles consistently emphasise root cause analysis and a sharp focus on systemic improvement – focusing on value, using its improvement methodologies, practices and KPIs, and implementing systems and processes that sustain improvements.

Most importantly, lean thinking also implicitly recommends judicious use of IT systems, particularly where

the intention is to use lean principles beyond the simple repetitive production environments for which it was originally intended – as in the Toyota Production System. Quite simply, lean practitioners recognise that in a volatile and/or complex supply chain, whether internal or external, modern manufacturers just cannot implement lean practices on visual queues and takt times alone. Thus, with appropriate solutions configured to collect data, disseminate information, enable visibility and automate background processes – such as those around material replenishment and assembly finishing, including outside the four walls of the factory – even complex manufacturing organizations benefit from lean principles.

That is the case no matter how prone production and supply chains are to the challenges of product mix, demand variability and/or the realities of breakdowns and resulting material availability problems. Timely information – aimed at delivering visibility of materials, WIP, scrap etc, as well as automating material flow and assisting with the understanding, communication and resolution of downtime issues – directly addresses the seven wastes.

Hence the rise of Lean Application Solutions in the form of e-kanbans, lean loop replenishment sizing applications, Web EDI and, most recently, Real-time Asset Management Solutions. Looking at the latter, those developed by Zebra Technologies Corporation, offers world-class solutions to optimize the flow of goods and manage assets across the global supply chain.

Zebra Technologies provides an integrated wireless infrastructure for real-time location, digital messaging, telemetry and wireless networking applications. Together these give manufacturers, spanning aerospace, automotive, industrial and government industries, the ability to continuously manage the physical location and status of their business critical assets, equipment and people. Whether tracking containers through a port, optimizing parts for manufacturing or managing ground support equipment at an airport, these automated solutions provide complete visibility and greater velocity to deliver measurable business improvement. In addition, the solutions support lean principles and reliably and cost effectively manage everything from material replenishment to defective materials and valuable mobile resources, delivering a return on investment within 3 to 12 months. Based on patented, standards-compliant technology resulting from a collective 100-plus years of development, Zebra Real-time Asset Management Solutions enable companies such as Whirlpool, BMW Subaru, Ford Motor Company, GETRAG FORD, Jaguar Land Rover and Hawker Beechcraft to reduce inventory, lower operating costs and improve operations through lean thinking.

ZEBRA REAL-TIME ASSET MANAGEMENT SOLUTIONS

Material Flow Solution — Zebra Material Flow Solution is a comprehensive execution management solution that streamlines the entire replenishment process. Material Flow Solution provides manufacturing operations with the ability to centrally manage and control supplier collaboration, internal supply and facilitywide communication across multiple facilities or within a single location. Designed to support and automate lean replenishment techniques, Material Flow Solution eliminates disjointed, labour intensive processes, granting every member of the supply chain access to actionable, real-time data – from the factory floor to internal and external supply. It enables all stakeholders to respond quickly to changes in inventory and production status, as well as customer requests. In addition, it easily integrates with ERP solutions, such as SAP, Oracle and QAD, to enhance operational visibility, throughput and quality, while also reducing inventory and labour costs.

MATERIAL FLOW SOLUTION DIRECTLY ADDRESSES ALMOST ALL OF THE SEVEN WASTES IN THE FOLLOWING WAYS:

- Decreasing on-hand inventory by 5-10%, by cutting the waste of over-production and dramatically reducing excess inventory
- Reducing labour costs by 15-20%, by tackling the wastes of waiting and unnecessary wastes of waiting and unnecessary motion
- Imrpoving asset utilisation by 5-10%, by reducing moves towards over-processing and preventing the wast of waiting

- Eliminating line stoppages and business interruptions, again cutting into the waste of waiting
- Decreasing expedite fees, directly impacting the waste of transportation
- Reducing cycle times and increase throughput - in line with lean's fundamental value and customer-pull principles

How Does it Work? Material Flow Solution automates the inventory replenishment process and reduces inventory holding costs by enabling line-side operators to trigger material requests from their workstations, either by pressing the wireless WhereCall RFID button, scanning a barcode, or by integrating with a third party system. In turn, material requests are delivered in an optimized priority, allowing requests to be processed rapidly and efficiently, so reducing lag time and line stoppages. This allows customers to maintain lower inventory levels at line side and in remote storage locations.

Similarly, Material Flow Solution increases labour productivity and improves asset utilisation by providing real-time material requests that show what is needed in a priority-based consumption demand process determined by part cycle times and pick and deliver sequencing.

As one leading international automaker in Indiana, US, stated: "After realizing more than 12% efficiency gains from implementing the Material Flow Solution in one part of our factory, we expanded use of the solution so that we now manage 750 parts across a span of more than 1.5 million square feet. With access to real-time data and analytics-rich reports, we have everything at our fingertips to make intelligent decisions and change business processes on the fly. Zebra has helped us take our lean manufacturing initiative to a new level."

Additionally, the Material Flow Solution maximizes the value of existing ERP software investments by leveraging their master data repository – and making the information flow. The solution returns real-time execution level information back into ERP to improve error proofing and data accuracy. Also, Material Flow Solution streamlines ERP's demand driven pull replenishment processes by reducing multiple steps into a single transaction, from start to finish. The solution provides real-time execution information that focuses on delivering the product, from external supplier or internal storage to the line-side point of- use, with actionable and easy-to-use instructions for plant floor operatives.

Zebra Vehicle Tracking & Management Solution (VTMS) Zebra Vehicle Tracking & Management Solution (VTMS) — Zebra Vehicle Tracking & Management Solution (VTMS) provides real-time information to track, measure and manage vehicles anywhere within a vehicle production facility, both indoors and outdoors. VTMS allows management and operatives to know, in real time or historically, exactly where a vehicle is or has been, with accuracy to within three meters. It communicates the physical location of vehicles by zone and parking slot via an interactive graphical map. VTMS is a ground-breaking step in automating vehicle tracking and management in today's assembly, delivery chain and fleet operations, and is the first to provide real-time information to today's manufacturing management community. VTMS is designed to support either repetitive or job-order manufacturing operations, with a focus on areas of the business and processes where units are off the line – typically including post-assembly verification and test processes, as well as quality repair, containment and shipping zones. Off-line processes are frequently a forgotten segment of lean manufacturing, and VTMS is one of the world's first systems to drive efficiency and optimization in this area.

VTMS ELIMINATES ALL OF THE SEVEN WASTES IN THESE AREAS IN THE FOLLOWING WAYS:

- Increasing vehicle throughput - by cutting out the overprocessing, unnecessary motion and transportation that result from otherwise limited vehicle location and status information
- Reducing dwell-time - not only by cutting out the waste of waiting, but also transportation and unnecessary motion
- Increasing labour productivity - again by attacking unnecessary motion
- Minimizing work-in-process inventory - which in turn impacts over-processing, over-production and ultimately also excess inventory

- Improving inventory accuracy - which in turn impacts over-processing improvements
- Reducing operating costs - primarily as a result of the over-processing improvements
- Reducing labour costs per vehicle - due to VTMS' impact on motion and transportation, but also the waste of defects
- Improving the overall order of delivery (OTD) cycle - by enabling lean value-adding and pull-based processes, in turn resulting from good, targeted information flow

How Does it Work? VTMS is composed of three interrelated solution elements: location, business process modelling, and mobile work force execution. The first element, vehicle location, provides an understanding of work cell or process area staging availability. Location tells us if an area is occupied or not occupied by a vehicle. The second element is business process modelling, which combines vehicle attributes, both physical and system generated, such as quality concerns or test results, with a model of the process areas. Modelling a process area provides the solution with an understanding of what work is performed where and in what sequence.

When these first two elements are combined, a vehicle can be evaluated to determine where it should be moved to next. The third element, mobile work force execution, then directs that movement request to the appropriate person or group. Mobile workers utilise WiFi connected devices that allow them to understand the priority and sequence of vehicle moves as well as the current location of the vehicle and where it is to be taken.

VTMS also provides for accurate planning, execution and monitoring of performance – making it the ultimate support tool for improving processes and creating efficiency in offline manufacturing areas.

CUSTOMER SUCCESS
GETRAG FORD'S MATERIAL FLOW DEPLOYMENT

GETRAG FORD is one of the largest manufacturers of automotive transmissions in the world. As part of its lean manufacturing initiative, the company implemented Zebra Material Flow Replenishment system to automate parts processes throughout its 2 million square foot assembly plant in Cologne, Germany. The results, according to Ralf Vierkotten, supervisor, logistics and material handling, GETRAG FORD, include improvements all the way from labour productivity up 20%, to equipment utilisation up 30% and on-hand inventory down from seven days to two. He also reports increased manufacturing floor space utilisation, improved manufacturing plant floor demand visibility and a one third reduction in daily forklift trips. And he adds that the company has almost completely eliminated line downtime due to parts shortages.

Consider those achievements in terms of lean's seven wastes: in this case their positive impact on excess

inventory, non-value add processing, waiting, unnecessary motion and transportation.

On excess inventory, for example, the result is reducing inventory carrying costs by $750,000 while the company also reports significant savings in handling and storage costs. As for unnecessary motion, the labour productivity and equipment utilisation figures speak for themselves – as does the fact that, for example, production line operatives no longer need to leave their workstations to help search for parts, or help material control determine the correct parts.

Equally, waiting has been massively impacted – and as a result, downtime slashed – entirely due to sorting out problems with parts shortages by enabling supplier visibility of changing production demand. The facility manufactures six different transmission varieties for global brands, including Ford, Mazda and Volvo – with output of more than one million assemblies per annum for OEMs in Argentina, China, Europe, Japan, South Africa, Taiwan, the Philippines and US. As a result, many different parts are consumed at lineside, all of which have to be well orchestrated from a supply standpoint, particularly to avoid the wastes of excessive movement and WIP inventory.

How Does it Work? Apart from the Material Flow Replenishment application itself, Zebra implemented: a wireless messaging infrastructure of 220 active RFID WhereCall buttons, each of which is associated with a specific part number on the assembly line; a network of 12 wireless WhereLAN location sensors; and five Åkerstrom rugged mobile computers, mounted on forklift trucks.

As each container of parts is consumed at lineside, the replenishment system communicates a request for another to that location. Specifically, at each location there is a predefined minimum inventory called a recorder point. When inventory reaches that point, the system makes its material request, mostly via wireless push-button or automatic (for robotic or highly automated processes) RFID tags positioned at the operators' workstations close to the inventory points. It's similar to an e-kanban system, except that not only does the system support internal and supplier material replenishment requests, but also manufacturing messages, such as requests to support organizations, such as electricians and toolmakers.

The solution tracks the exact time of all part requests, automatically prioritizes them and sends instructions to material handling drivers – whose vehicles are equipped with vehicle-mounted WiFi terminals – telling them where to pick up and deliver the parts throughout the assembly plant. The system also alerts suppliers when parts are needed, with its Supplier Portal allowing them to receive real-time demand signals and ship parts from within the portal. It then manages synchronous flow of those parts from the supplier to the plant warehouse dock door, from the warehouse to the staging lane, and ultimately to the assembly-line operator who originated the request. Hence the outstanding end-to-end impacts on inventory, productivity and waste.

As Vierkotten puts it: "The system moves us a long way toward our ultimate goal of a completely forklift-less production operation, as we are now operating leaner than ever before. Production-line employees no longer need to leave their workstations to help search for parts or to help material control determine the correct part. All they have to do is push a WhereCall active RFID button, and the system notifies all the required parties – from the line-side to the forklift driver to the internal warehouse – that more parts are needed. This intelligent automated system supports our lean manufacturing processes as we benefit from real-time inventory consumption and can execute replenishment orders just in time."

CUSTOMER SUCCESS
JAGUAR LAND ROVER'S VEHICLE TRACKING & MANAGEMENT DEPLOYMENT

It's a similar story at Land Rover, which in 2007 extended its existing lean manufacturing to cover vehicles rolling off the production line at its Solihull, England production facility, by implementing Zebra Solutions Vehicle Tracking & Management Solution (VTMS). Newly assembled vehicles move around the site as they are prepared for dealer orders – undergoing testing, configuration setting, rework, rectification etc – so it was a difficult and manually intensive process to establish their precise location and identify and direct each vehicle to the next process.

Hence the goal of this lean project, which was to minimise dwell times between end-of-line and the delivery chain. Land Rover chose to build on its earlier lean manufacturing material replenishment project for line-side inventory, re-using that system's RFID technology to track vehicles efficiently. Basic requirements included: increased visibility of all finished vehicles at the facility, including in the shipping yard; better coordination of post-assembly verification and test processes; and improved management of the quality repair, containment and shipping zones.

Following completion of the project, Dave O'Reilly, IT manager for manufacturing and purchasing at Jaguar and Land Rover, reports key benefits as: improved labour productivity, specifically in terms of vehicle status checks and searching for vehicles in the yard; higher production velocity and throughput of cars; the ability to expedite shipping on a daily basis; and better use of Land Rover's facility, due to reduced inventory and carrying costs, alongside better space utilisation.

O'Reilly also cites improvements in vehicle quality management, achieved by implementing procedures that ensure vehicles are shipped only once all steps are completed and verified. And he reports improved documentation covering both the vehicles and the processes, as a result of data capture – not only of each car's progress, but also of the information necessary for flow analysis to enable lean-based continuous improvement. Examining those achievements in terms of lean manufacturing's seven wastes, again we find: significant cuts in excess inventory, due to higher production velocity and throughput, translating directly into lower WIP carrying costs; decreased waiting, due to efficient vehicle finding and assessing processes; and reduced motion, since operatives no longer need to search the yard to find vehicles.

How Does it Work? The solution relies on reusable active RFID tags (transmitters) placed in vehicles as they leave the captive sequence of the assembly line. Each tag is linked in the VTMS database to the VIN record which contains all of the attribute and quality data associated to the vehicle. As the vehicle moves through the offline process areas, Zebra WherePort exciters force the RFID tag to blink, which allows the system to capture process area arrival and departure times precisely. As the vehicles move through processes or in and out of storage locations, 130 wireless WhereLAN location sensors (on ceilings and outdoors on light poles and building corners) precisely locate the vehicle down to a parking spot or work cell. This information goes to Zebra Visibility Server Software, which analyses the time vehicles take to pass through key processes, comparing those with the expected time to identify main areas for improvement. Zebra VTMS includes workflow, with configurable rules for vehicle model, destination or task, and the data can also be used to issue dwell time alerts or create alternative workflows, if the system detects bottlenecks. Also, shipping yard staff with handheld RFID readers scan the vehicle RFID tags to verify vehicle shipping status, to ensure that vehicles are not released before completing required processes.

In the future, Land Rover is considering expanding the VTMS to additional facilities as well as other processes within its factories and in its extended supply chain.
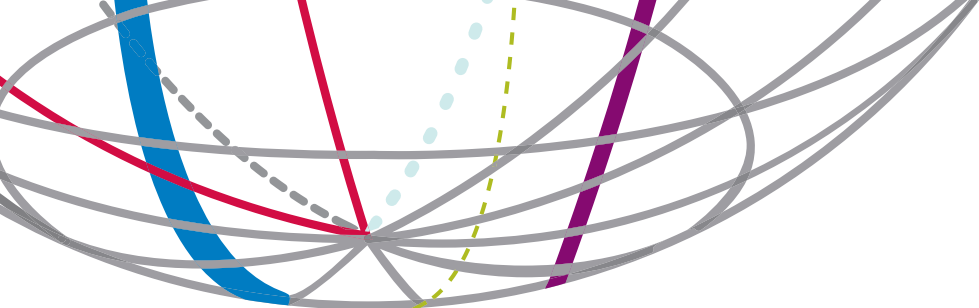
CONCLUSION

By adopting lean manufacturing techniques, supported by Real-Time Asset Management Solutions, you can reduce and/or eliminate the seven wastes of manufacturing. That's because timely information – aimed at delivering visibility of materials, WIP, scrap and assets, as well as automating material and process flows – is the key to improvement and becoming leaner.

Zebra offers a broad range of scalable Real-time Asset Management solutions that address all wastes, and significantly reduce costs, inventory and cycle times, while increasing throughput and asset utilisation. The company provides an integrated wireless infrastructure for real-time location, digital messaging, telemetry and wireless networking applications. Together these give manufacturers, spanning aerospace, automotive, industrial and government industries, the ability to continuously manage the physical location and status of their business critical assets, equipment and people.

Based on patented, standards-compliant technology, resulting from a collective 100-plus years of development, Zebra Real-Time Asset Management Solutions enable companies such as Whirlpool, Subaru, Ford Motor Company, GETRAG FORD, Jaguar Land Rover and Hawker Beechcraft to reduce inventory, lower operating costs and improve operations through lean thinking.

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