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Traceability 4.0: The fundamental element of global manufacturing

Success in the age of Industry 4.0

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Introduction

The breadth and scope of traceability has expanded significantly over the years along with advances in technology, making it a ubiquitous and critical application for today's world-class manufacturers. We'll explore the evolution of traceability and its nuances in this article and explain why the latest phase, Traceability 4.0, is not just about tracking products and components throughout the supply chain but also optimizing productivity, quality and brand reputation within the manufacturing operation by tying product to process parameters.

Traceability is a much-used term these days in manufacturing and supply chain management. Like many industry phrases (Internet of Things, for example), traceability can mean different things to different people or organizations. For that reason, "Traceability 4.0" is the term that Omron has coined to describe the current and future phases of traceability in a global context. Traceability definitions have been evolving since the invention of automatic data capture equipment – primarily barcode readers – over 40 years ago. Since then, traceability applications have evolved to support industrial development from both a product technology and business process perspective.

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Contents

Traceability 1.0: Product visibility....4

Traceability 2.0: Supply chain visibility....5

Traceability 3.0: Line item visibility....6

Traceability 4.0: Process visibility....7

Summary....8

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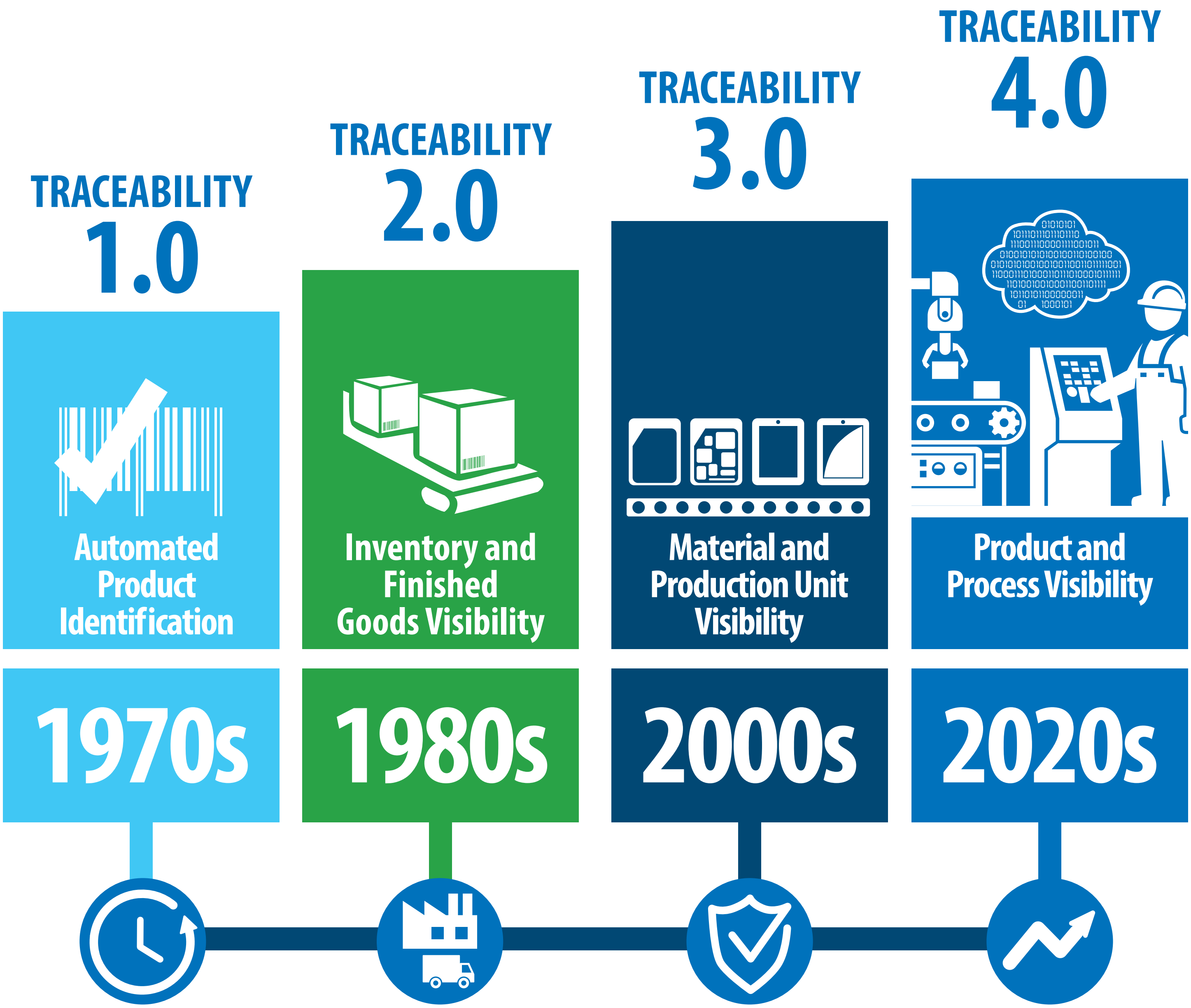

4 phases are distinct and overlap, to bring the full value of Traceability

Traceability 1.0: Product visibility

Traceability 1.0 is about automatically identifying products to drive accuracy and efficiency. Barcode readers were initially used in simple manufacturing processes, yet grew rapidly in adoption. The ability to mark a part and then track it was groundbreaking.

Barcodes became, and still are, a necessary core in manufacturing and industry to improve operator efficiency and productivity. In manufacturing, this is quite often the "first step" in implementing traceability solutions.

The barcode's first grandscale commercial use was in retail operations. Prior to the advent of barcodes, cashiers had to key the product and price into a cash register. The automatic data capture enabled by barcodes saved a significant amount of time, improved accuracy, and increased throughput. Developed for retail, the first Universal Product Code (UPC) debuted in 1974 and they are still in use today

Another adaptation of bar code use, still prominent today, is the use of 1D barcodes on test tubes containing animal or human specimens. Tubes of blood or other biological material are sent to labs where they are placed in clinical diagnostic instruments. Those instruments then run various tests on samples, such as lipid panels and other medical tests. Barcodes are used to track individual specimens and to ensure that test results are associated with the appropriate specimen and patient.

Today, there are many more widespread applications in use. Traceability 1.0 is transformational in manufacturing and industry for efficiency and accuracy when processing a large number of discrete items or transactions.

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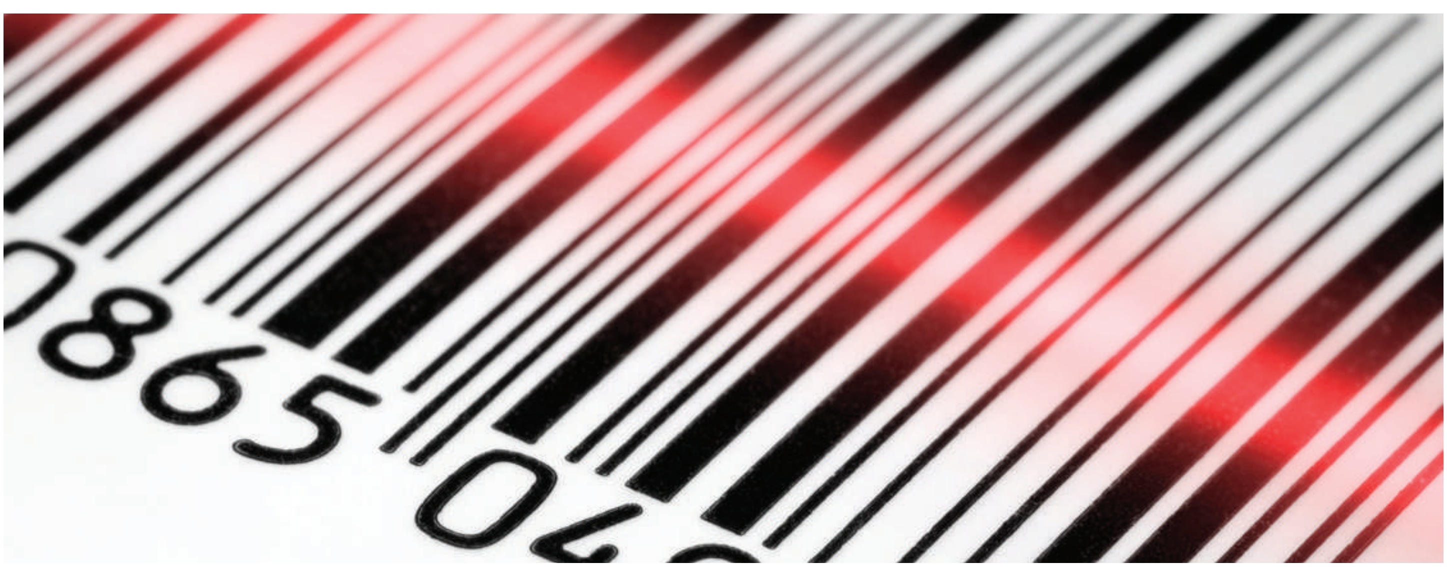


Traceability 2.0: Supply chain visibility

Traceability 2.0 is about managing inventory and meeting the needs of society. Now that barcodes were being applied to manufactured items, manufacturers recognized additional uses for them. They could track materials within the manufacturing facility and throughout the supply chain.

Comprehensive tracking, from original raw materials to finished products for the purpose of optimizing inventory management and reducing cost, became possible. At the same time, consumers became more quality- and health-conscious, and the media became more aggressive in responding to product quality issues.

Whether a supplier, manufacturer or consumer, no one wants to be involved in a product recall. Product defects and recalls can happen in any industry. Many may remember the Tylenol recall in 1982. This incident prompted a reform for packaging of over-the-counter drug products. The recall cost in 1982 was $100M. In 2000, Bridgestone and Ford lost massive brand appeal and spent $5.6B on allegedly defective tires, recalling almost 20 million tires. The 2016 Samsung Note 7 recall due to fire and burn hazards remains infamous.

Today, across industries and throughout supply chains, recalls can cause serious issues. The demand for Traceability 2.0 has skyrocketed, largely to address these issues and broader social needs and awareness.

Traceability 2.0 enables targeted product recalls according to date and lot codes. This reduces the cost of quality improvement and also increases consumer confidence, as manufacturers can now pinpoint the source of the problem within their processes. Much has been reported about defective products in many industries, from tainted food to defective automotive parts.

> Traceability 2.0 enables targeted product recalls, reducing the cost of quality improvement and increasing consumer confidence.

Retailers push traceability requirements onto manufacturers and require that barcodes themselves have high standards of quality. The retail industry as well as the United States Food and Drug Administration (FDA) for the manufacturing of medical devices (Unique Device Identifiers or UDI), has adopted the International Organization for Standardization (ISO) barcode quality specifications, which impacts multiple levels within the respective supply chains.

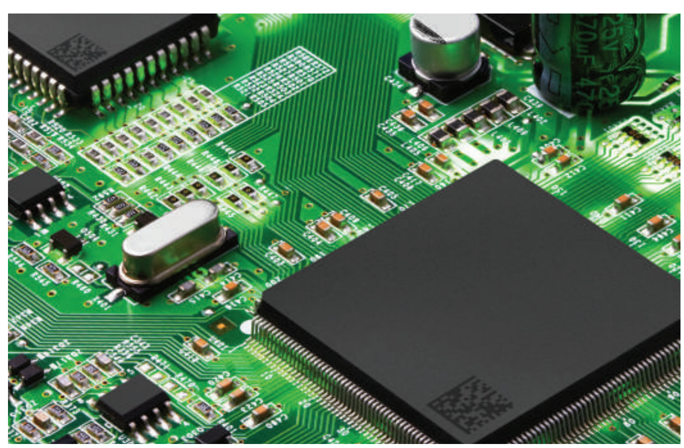
Traceability 3.0: Line item visibility

Traceability 3.0 is about the optimization of manufacturing and supply chain security by focusing on material, the second of "the 4Ms of lean manufacturing": Man (People), Material, Machine and Method. For this paper, "Material" applies to all that is necessary to build a product: raw material, components and subcomponents, as well as the finished product with serial number. Manufacturers began to extend traceability to their suppliers by requiring barcodes and other identifying information be placed on components and packaging. Some refer to this as component, subcomponent or line item traceability. As more suppliers began adding information, manufacturers were able to optimize manufacturing processes and product quality even further by employing traceability within the manufacturing facility.

Traceability 3.0 is also about the ability to perform preventative control, before an emergency or a quality issue occurs. Subcomponents can now each be identified, tracked and inspected for quality before final assembly. When a manufacturer is able to go back to the last acceptable checkpoint, adjustments can be made in final production to assure quality products are released for shipping. The introduction of Data Matrix (developed by a company in Omron's acquisition genealogy) and other 2D symbologies greatly facilitated Traceability 3.0, as symbols could be substantially smaller than their 1D counterparts while containing more data. This is especially important in the electronics industry, where device components continue to decrease in size. The development of the Direct Part Mark (DPM) occurred during this phase of the traceability evolution because of the need for robust identifiers to withstand harsh manufacturing or environments. Manufacturers etch DPM symbols directly onto materials such as metal or plastic, eliminating the need for easily-damaged barcode labels.

> Traceability 3.0 provides greater ability to ensure authenticity of products and a strong foundation for anti-counterfeiting programs.

Lastly, Traceability 3.0 provides manufacturers with a greater ability to ensure the authenticity of their products and a better foundation for anti-counterfeiting programs. Counterfeit automotive parts are estimated to cost the industry between $10 billion and $30 billion per year. By identifying all of the components in an assembly or product and improving the resilience of 1D barcodes and 2D symbols, manufacturers are able to implement anti-counterfeiting programs that successfully reduce counterfeit products from entering the supply chain.



Traceability 4.0: Process visibility

So far, we have discussed product, component and supply chain tracking as key traceability goals. Traceability 4.0 is the union of all these, along with machine and process parameters to achieve the highest level of manufacturing. This includes Overall Equipment Effectiveness (OEE) as well as production and quality data to improve overall manufacturing effectiveness. Although some manufacturers are already employing Traceability 4.0, it represents the future for the majority of manufacturers.

A similar way of describing Traceability 4.0 is the complete implementation of traceability in the context of the 4 Ms of lean manufacturing. Manufacturers can now know everything there is to know across their enterprise about a part or product, including its complete genealogy. Traceability 4.0 greatly enhances root cause analysis. On which machine was this product produced and at what time? Who was operating the machine? Where is the production bottleneck located? The potential diagnostic scenarios are virtually limitless. Just one example: Machine temperature and torque were within specifications, and yet were operating at the upper control limits when the production failure occurred. Having this information would potentially allow the manufacturer to adjust the upper control limits of the machine and improve process yield.

Substantial improvements come to light in many areas with Traceability 4.0. The ability to identify specific product failures with detailed operating parameters and conditions enables faster and more precise root cause analysis. Manufacturers can also drive manufacturing decisions and processing with Traceability 4.0. Through what process does a particular part move during production? What route does a part take throughout the manufacturing process? Which components are used on a specific subassembly? Assembly verification, quality assurance, and bill of material control are all optimized with Traceability 4.0.

Traceability 4.0 is leading manufacturers to the forefront of manufacturing and brand protection.

In the automotive industry, Traceability 4.0 can go beyond geometric dimensioning and tolerancing (GD&T). Components that must fit together precisely, such as pistons and engine blocks, are categorized and identified based on their exact GD&T measurements and then automatically matched based on their corresponding IDs to achieve extremely high precision and performance.

One electronics manufacturer has developed a Traceability 4.0 solution using Omron technology to track a product through all processing steps. Each processing machine writes a proprietary DPM on each product to create a real-time manufacturing genealogy in addition to the machining of the product.

Finally, in an advanced state, Traceability 4.0 systems can make automatic decisions that optimize equipment and processes based on acquired data, including automatic predictive maintenance. This is facilitated by smart sensors, AI controllers, RFID and advanced data management software. This process knowledge can then lead to improvements in other facilities across the enterprise and around the world.

Summary

All levels of traceability are critical to the success of manufacturing. In fact, most industries will see and use all levels in their plants or facilities. One phase is not "better" than the other; the full complement is their strength. The evolution of traceability is the direct result of business needs and is crucial in the hyper-competitive world of global manufacturing.

While similar in many ways to Industry 4.0, Traceability 4.0, and all its phases, is different in several ways.

Timing and availability is one key difference. When speaking of Industry 4.0, in some cases there are decades between advancements, and generally they are not being developed, or used, at the same time. Many steps of this progression were sequential.

The concepts and technologies of traceability began just 40 years ago, and are actively building upon each other and are being used concurrently, for both bettering production and sparking new technology developments.

The other large difference we see is the focus of Industry 4.0 compared to that of Traceability 4.0. They both focus on improving and connecting digital and physical technologies to optimize manufacturing and improve yield. Traceability, however, brings an additive dimension – ensuring quality components and end products. It is this laser sharp focus on credibility and brand protection that true traceability can deliver.

Omron's vision has always included the working relationship between people and robots. We call this Highly Diverse Traceability: tracing the fusion line of people, robots, machines and devices without interruption.

Traceability 1.0 generates enhanced efficiency and productivity. Traceability 2.0 helps to optimize inventory management, product quality, safety, and regulatory compliance. Traceability 3.0 is essential to anti-counterfeiting programs and to product and component compatibility optimization. Traceability 4.0 achieves the 4 Ms, optimizing overall manufacturing effectiveness and brand protection, and also introduces AI into certain elements of process control.

Crucially, the four phases of traceability have not cannibalized one another. They have in fact been accretive, and will continue to build upon each other. Transactional efficiency, social needs, supply chain management, and manufacturing optimization will only become more important in the coming decades.

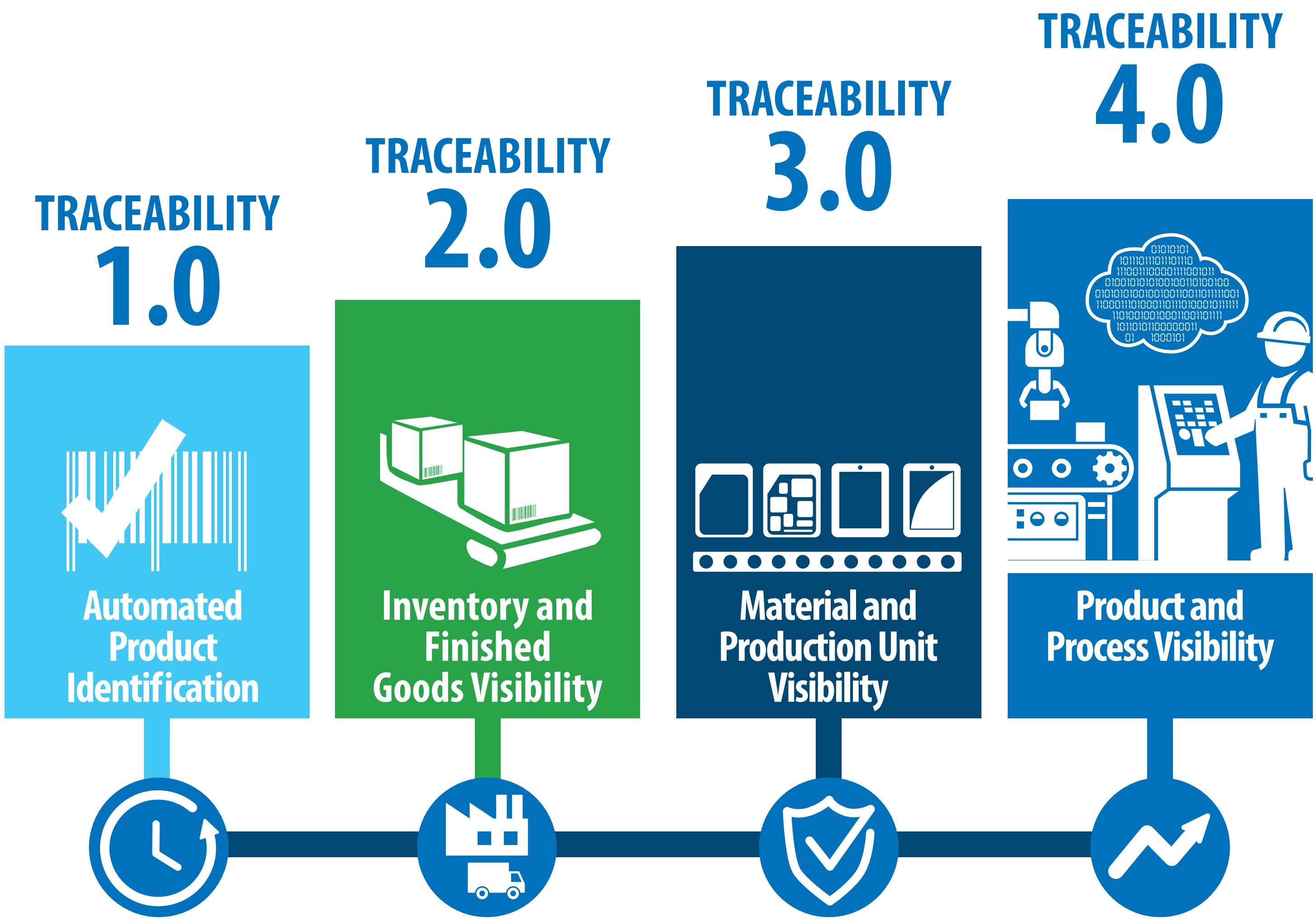
Traceability 1.0 is still used extensively in manufacturing and retail environments and many manufacturers continue to refine their Traceability 2.0 programs. The FDA's UDI program is a Traceability 2.0 program that is still active over a decade since it was established. Manufacturers will continue to develop Traceability 3.0 programs to optimize supply chain management and product precision and performance. As a culmination of each of these phases, Traceability 4.0 is leading manufacturers to the forefront of traceability and brand protection.

Omron is uniquely positioned to provide significant and innovative value to customers in this space. Our global portfolio of traceability products and solutions is integrated, intelligent, and interactive. Our core "MVRC" offerings (mark-verify-read-communicate) include barcode readers, ISO-compliant barcode verifiers, laser markers, and RFID. Omron has a complete automation platform featuring programmable logic controllers, motion controllers, machine vision systems, safety technology, and robotics to facilitate a complete

Summary continued

traceability solution for data management, inspection, and material handling. Our IoT enabled devices communicate data seamlessly with each other and across multiple data layers within an organization (MES or ERP). This data connectivity enables analysis for continual improvements to be realized. We were present at the beginning of traceability's evolution and we will continue to drive that evolution forward. Omron has facilitated many Traceability 4.0 applications in the digital, automotive, and food and commodities industries with exceptionally positive results. Our knowledge and expertise will continue to drive further productivity for our customers and end users.

Let Omron show you examples of our past successes, discuss with you how we can simplify your application, and demonstrate how we can help you attain Traceability 4.0. Contact us toll free at: 800.556.6766 or visit automation.omron.com.



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About the authors

Andy Zosel, President and Chief Executive Officer, OMRON Microscan

Andrew Zosel brings more than 25 years of experience to the technology and automation markets. Andy's company leadership and industry background include strategic decision making, technology project management, and innovative problem solving in opto-mechanical engineering, process development, product management, and B2B technology marketing.

Since joining Microscan in 1997 as a design engineer, Andy has held multiple leadership roles in customer service, marketing, and engineering. Prior to his recent appointment as President and CEO of OMRON Microscan, Andy served as Senior Vice President of Engineering and Commercial Operations. In addition to high-speed machine vision systems design, Andy's broad industry experience includes PLC programming for sawmill automation, SPC for semiconductor processing, and assembly of miniaturized systems for electronics.

Andy earned his MBA from the University of Phoenix and his BS in Mechanical Engineering from the University of Washington. During his career, he has attained multiple certifications in product and project management, including a Lean Six Sigma Black Belt. Andy holds 5 patents, including 3 related to designs in Micro-Opto-Electro-Mechanical-Systems (MOEMS).

Kenta Yamakawa, Senior Vice President, OMRON Microscan

For the past 20 years, Kenta Yamakawa has worked in technology, engineering and market planning. Kenta's areas of specialization are social system automation and factory automation. Kenta has deep industry experience in business planning and strategic decision making, technology and product project management, and innovation challenges in the fields of sensor engineering, manufacturing process development, and B2B marketing research.

Kenta joined OMRON Corporation in Japan in 1999, and since 2017 has been a corporate planner for OMRON Microscan in the US. His focus is on post-merger integration and business strategies, while overseeing execution of those plans. Since first joining OMRON as a mechanical design engineer, he has held several leadership positions in factory automation and sensing technical research. Prior to his appointment as Senior Vice President, Kenta led new IoT projects which were designed to overcome social needs by questioning and changing the conventional approaches. His expertise led the teams through planning, partner strategies, joint development, risk management, and customer challenges in sensor applications.

Kenta earned both his Bachelor and Master of Mechanical Engineering degrees from Tokyo Metropolitan University. Kenta holds 11 patents, primarily related to designs in factory automation sensors.

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