

The way to higher product quality and better warranty management: Digital manufacturing for product and process traceability

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white paper



- ▶ Digital manufacturing for traceability aids warranty management and quality assurance.

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► Overview

Driven by high-profile regulations compliance like the TREAD Act, warranty management has become a hot topic across industries worldwide. Recalls are costly and time-consuming events that should be avoided entirely. But without adequate process traceability and product genealogy, too many customers will get defective products and too many products will be recalled for repair or replacement even though they are not defective. Both scenarios have enormous implications for the quality-conscious manufacturer that gets rated on the number of recalls it performs – not to mention the enormous direct costs. The core issue is visibility into product quality.

Companies must contain potential quality problems *before* the product leaves the plant while providing detailed product genealogy information to trading partners. Today, few manufacturing enterprises enjoy a true component and process traceability system that enables this. If they do, the system likely does not extend outside to trading partners, contract manufacturing plants, distribution centers and transportation providers.

A complete digital manufacturing for traceability system minimizes the cost of product recalls and eliminates recalls altogether.

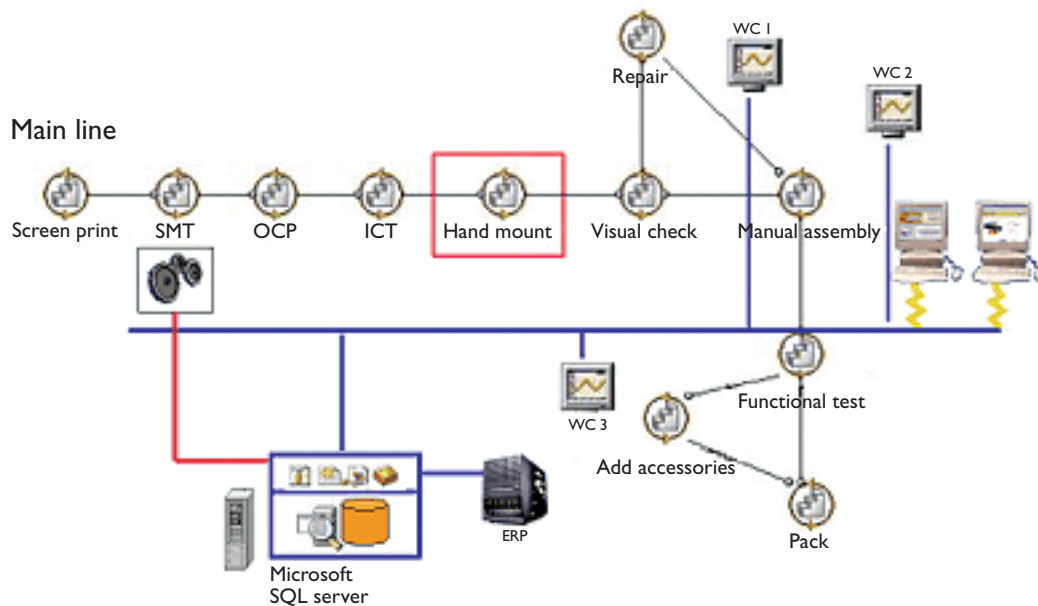
A traceability system that solves this problem will achieve two primary goals:

- *Minimize the number of products that must be recalled* when a manufacturing flaw is found by identifying *only* the specific serial numbers that were built with the faulty component or by the faulty process.
- *Eliminate recalls in the first place* by providing real-time reports on the machines, components, stations, shifts and operators involved in the defective product and processes *before* the product is shipped.

The benefits of improved production quality, cost containment and product warranty management through part and process traceability – elements of a digital manufacturing¹ system – can ultimately improve customer satisfaction by reducing the risks and costs of poor quality and recalls.

¹ Digital manufacturing is a business strategy, enabled by technology, to manage all facets of creating, optimizing and executing manufacturing processes. For more on digital manufacturing visit www.ugs.com/tecnomatix.

X-factory architecture applied to manufacturing line



▶ The cost of poor quality

The most severe outcome of poor quality is product recall. The impact of recalling thousands of products is tremendous. Warranty costs in the automotive industry alone exceed \$9 billion per year. The short- and long-term costs of a recall can be enormous and is influenced by many factors. Some costs are directly related to recall activities, such as investigation of the product failure, customer notification of the recall,

transportation of the recalled product, redesign and repair costs and the loss in value of the defective product.

Other costs are indirectly associated with the product recall and poor quality, including the loss of sales due to negative publicity. The bottom line is that poor quality can have a dramatic effect on a manufacturer's profits.

Warranty costs for leading North American manufacturers range from 2 percent to 5 percent of sales, according to AMR Research.

▶ The goals of traceability

Manufacturers must continuously improve their processes, with the goal of delivering products with no discernible defects. This is complementary to Six Sigma goals that strive to improve customer satisfaction by virtually eliminating product defects in the first place. To move toward Six Sigma, manufacturers must be able to trace the manufacturing process to both anticipate and detect a nonconforming process *during* production, *before* the product is shipped to the OEM or the end-customer.

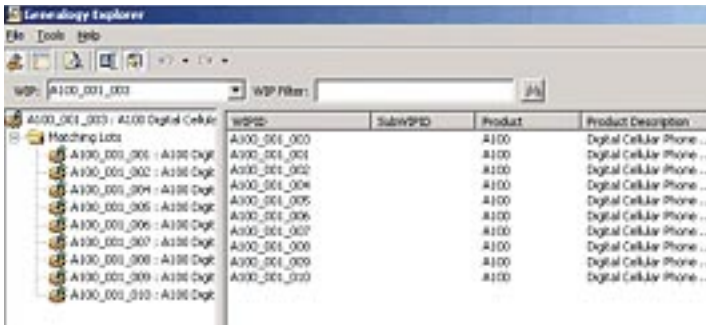
The essence of digital manufacturing for traceability enables manufacturers to better control the quality and performance of manufacturing processes and assets. The result is reduced cost and continuously improved manufacturing processes – both in planning and execution. This drives product quality, production throughput and company profitability.

Goals of digital manufacturing for traceability

- 1. Identify defects prior to customer delivery to reduce in-process costs (proactive, short-term benefit) and eliminate the need for and costs of a recall (proactive, long-term benefit)*
- 2. Identify products impacted by the defect after customer delivery to minimize recall costs (reactive, short-term benefit)*

► What does traceability do?

Specifically, a digital manufacturing for traceability system combines production planning, material management, performance monitoring and quality management. It automatically captures detailed manufacturing process information from the shop floor, compares it with the manufacturing process plan and alerts management to any gaps that could lead to product quality issues.



WOP	SubWOP	Product	Product Description
A100_001_000	A100_001_000	A100	Digital Cellular Phone ...
A100_001_001	A100_001_001	A100	Digital Cellular Phone ...
A100_001_002	A100_001_002	A100	Digital Cellular Phone ...
A100_001_004	A100_001_004	A100	Digital Cellular Phone ...
A100_001_006	A100_001_006	A100	Digital Cellular Phone ...
A100_001_007	A100_001_007	A100	Digital Cellular Phone ...
A100_001_008	A100_001_008	A100	Digital Cellular Phone ...
A100_001_009	A100_001_009	A100	Digital Cellular Phone ...
A100_001_010	A100_001_010	A100	Digital Cellular Phone ...

Digital manufacturing for traceability information by component date code indicates all operations performed using that date code of parts, including part retrieval and setup on machines and which specific products (by serial number) were built with those parts.

Digital manufacturing for traceability also provides detailed historical data on the production process for any given work order – enabling investigation into the root cause of quality issues.

Varying levels of digital manufacturing for traceability are in use today.

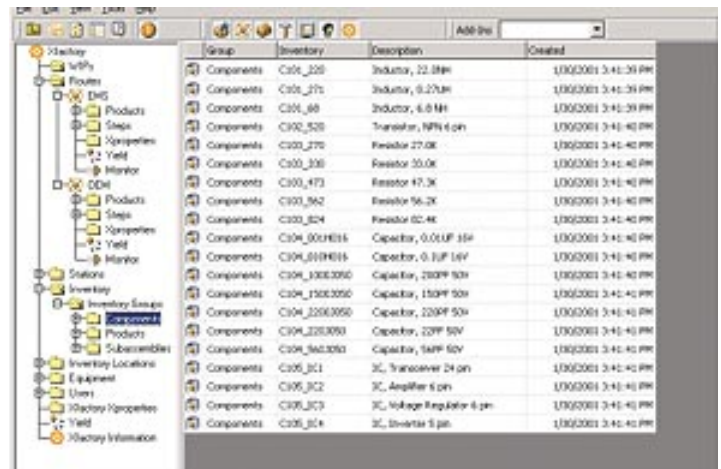
Minimally, the system tracks product genealogy information, meaning that it identifies which specific parts or components are assembled into which specific products. In this case, a component could be either a single, discrete element, such as an integrated circuit (IC) chip on a printed circuit board, or a pre-assembled unit that is part of a larger assembly hierarchy, such as a ball joint on an automotive suspension subassembly. When a flawed component is identified, the digital manufacturing for traceability system provides detail on *only* the products – via serial number – that were built with the same lot of defective components.

The second level of digital manufacturing for traceability tracks very detailed process-related information, such as exactly when and where a specific part was assembled, which machine or device was used and who performed the operation. With this information, digital manufacturing for traceability identifies real-time errors that have occurred during the manufacturing process: such as feeder nozzle

errors on a circuit-board assembly machine or incorrect weld gun positioning. This level of traceability more precisely determines the root cause of the defect.

A third and critical level of digital manufacturing for traceability allows a comparison between the planned and the executed manufacturing process in order to *proactively* identify nonconformities that are in-process but *prior* to customer shipment, eliminating the cost of recalling the product in the first place.

Finally, at its highest level, the verification functionality of digital manufacturing for traceability helps to proactively prevent errors before and during production. Digital manufacturing manages process execution by interactively guiding shop floor workers through tasks – in real-time – preventing them from performing a nonconforming task, or preventing a worker from performing a task he/she is unqualified to perform. For example, digital manufacturing lets a specific (qualified) user know which specific parts must be loaded onto a specific machine for a specific order. And, when the part is loaded onto the machine, the system provides a mechanism for verifying that this is the part-machine combination desired. If an incorrect combination is detected, an alert is generated that allows the user (or the supervisor) to make an immediate correction. This saves production time, money and resources by avoiding nonconfirming tasks or processing products that contain defective components.



Group	Inventory	Description	Created
Components	C00_220	Inductor, 22.0m	1/02/2001 3:41:39 PM
Components	C00_271	Inductor, 0.27m	1/02/2001 3:41:39 PM
Components	C00_68	Inductor, 6.8 mH	1/02/2001 3:41:39 PM
Components	C00_520	Transistor, NPN 4 pin	1/02/2001 3:41:40 PM
Components	C00_270	Resistor 27.0k	1/02/2001 3:41:40 PM
Components	C00_330	Resistor 33.0k	1/02/2001 3:41:40 PM
Components	C00_473	Resistor 47.3k	1/02/2001 3:41:40 PM
Components	C00_562	Resistor 56.2k	1/02/2001 3:41:40 PM
Components	C00_824	Resistor 82.4k	1/02/2001 3:41:40 PM
Components	C04_001K016	Capacitor, 0.01uF 16V	1/02/2001 3:41:40 PM
Components	C04_010K016	Capacitor, 0.1uF 16V	1/02/2001 3:41:40 PM
Components	C04_100K050	Capacitor, 100pF 50V	1/02/2001 3:41:40 PM
Components	C04_100K050	Capacitor, 100pF 50V	1/02/2001 3:41:40 PM
Components	C04_220K050	Capacitor, 220pF 50V	1/02/2001 3:41:40 PM
Components	C04_560K050	Capacitor, 560pF 50V	1/02/2001 3:41:40 PM
Components	C05_3C1	3C, Transceiver 8 pin	1/02/2001 3:41:40 PM
Components	C05_3C2	3C, Amplifier 8 pin	1/02/2001 3:41:40 PM
Components	C05_3C3	3C, Voltage Regulator 8 pin	1/02/2001 3:41:40 PM
Components	C05_3C4	3C, Inverter 8 pin	1/02/2001 3:41:40 PM

Traceability information by product serial number reveals all operations performed on that product, including time stamp and operator name and a list of components and date codes being traced in that product.

► Results of digital manufacturing for traceability

A large amount of data is collected by the digital manufacturing for traceability system throughout the planning, setup and execution of the production process (see the two figures on page 3). During the setup of production, the specific part lots at each process station are recorded. During execution of the process, the specific genealogy of each product is recorded by knowing the exact time that each product is assembled at each station. Also, process errors (or gaps between the process plan and what's actually executed) are collected in real time during production. Now, given all this data, several different actions can be taken, most importantly, corrective action and root cause analysis.

The manufacturer needs to know:

- What component(s) failed?
- Precisely what products included the defective component?
- Do those products need to be removed from work in process or recalled from the customer?
- Precisely what process did defective components and products go through?
- Which people were involved?
- Was the defect due to bad design, bad material or a bad process?
- How can the process be improved to detect or prevent such defects in the future?

A lot of manufacturing happens before a problem is detected – on average, more than five years of it. The average is 63.6 months!

AMR Research event:
Technology Priorities for the Automotive Industry Oct 7, 2003

Despite the pre-emptive nature of digital manufacturing for traceability, if a product defect is found, a failure analysis is performed to identify the defective component. Once the defective component has been identified, the system produces a report with detailed information about the component, including lot number and vendor.

The next step determines in which products the defective part was used. A defective lot of components may have been used in several products, which are all now faulty. Or, unused defective components in inventory or another storage location must be retrieved to prevent them from being used in production.

After analyzing all affected products, manufacturers must determine the root cause of the problem. With digital manufacturing for traceability, the manufacturer can apply corrective action by tracing the defective product back through all production and inspection phases to the raw materials, specific equipment and individuals involved in the manufacturing process.

Further analysis identifies specific process abnormalities that may have occurred during production to cause the defective component. Examples of process abnormalities are part placement errors or inappropriate storage of a component or assembly. Faulty products may share common conditions, such as a common process or common supplier, which can then be corrected to improve product quality. The correlation of error information and historical process data allows manufacturers to implement corrective action and make the most informed quality and warranty management decisions.

Short-term benefits include:

- *Operator error proofing* ensures the correct part is handled by a qualified worker during assembly, minimizing re-work costs that would otherwise be incurred
- *Automatic machine programming* ensures that no miscommunication occurs between the process plan and how machines execute on that plan
- *Early identification of defective parts* in-process reduces the chance of performing non-value-added work in subsequent operations, saving the associated material and resource costs of those unnecessary steps
- *Minimal quarantining of defective parts* in inventory or work-in-process means reduced labor costs applied to this function, freeing up resources for value-added tasks
- *Matching engineering change notices to defective lots* or parts-in-process saves product design/engineering re-work
- *Catching defects through process monitoring before* the product is further processed means lower production costs and less waste
- *Catching defects through process monitoring before* the product is shipped to customers means fewer costly recall events

Long-term benefits include:

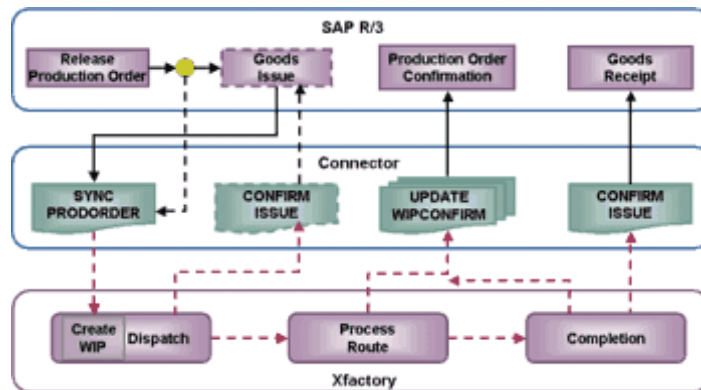
- *Identifying which specific parts/lots are defective* by linking them to faulty processes means fewer products need to be recalled per recall event, saving the shipping and services costs, among other direct savings
- *Fewer recalls and fewer products involved in each recall* enhances customer perception of quality and minimizes negative quality perception/litigation

► Conclusion

Soon product and component traceability will be mandated, both by customers and governments. However, manufacturers should be proactive with traceability initiatives since the costs of warranty management, product recall and poor quality are extremely high. Proper traceability initiatives require a link between the manufacturer's production planning and execution systems. A complete digital manufacturing for traceability system will minimize both the likelihood and cost of product recalls and save enormous time and money on defective products that are still in process.

A complete digital manufacturing for traceability system will minimize both the likelihood and cost of product recalls.

Properly implemented, a digital manufacturing for traceability system enables manufacturers to better control the quality and performance of manufacturing processes in a mixed IT, mixed automation and multi-tier supplier manufacturing environment. It reduces the manufacturing cost of quality and warranty management while minimizing the negative impact recalls and poor quality have on the brand. The result is improved customer satisfaction and increased profits for the organization.



About UGS

UGS is a leading global provider of product lifecycle management (PLM) software and services with nearly 4 million licensed seats and 42,000 clients worldwide. The company promotes openness and standardization and works collaboratively with its clients in creating enterprise solutions enabling them to transform their process of innovation and thus begin to capture the value of PLM. For more information on UGS products and services, visit www.ugs.com.

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