

TRACEABILITY: SOLVING CHALLENGES & ADDING VALUE IN ELECTRONICS MANUFACTURING

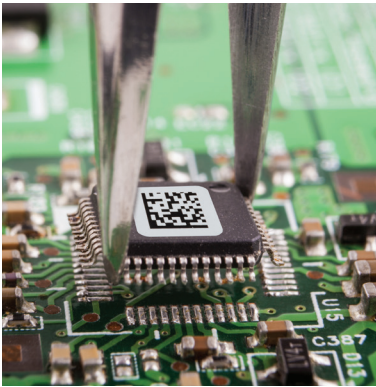


What is Traceability?

According to ISO 8402, traceability is the “ability to trace the history, application or location of an entity by means of recorded identifications.” Traceability also has ties to Six Sigma programs as it provides vital tools that help improve customer satisfaction by enhancing processes and protocols that can reduce the liability associated with electronics manufacturing.

A traceability system can provide clear insight into the various steps in the manufacturing process that impact a finished product. That information can then be used for a variety of purposes including:

- Process improvement
- Regulation compliance
- Direct & indirect cost savings
- Defect resolution
- Brand integrity



Traceability and its residual benefits within the electronics assembly industry have been familiar topics in research papers over the past few years. However, the risks associated with the increasingly complex nature of supply chains have made awareness on the topic more critical for manufacturers. The impact of product defects and regulatory conditions challenge all assemblers, regardless of their size.

When it comes to establishing a traceability system to meet customer expectations, improve production visibility and align with financial needs, there are a variety of options to consider, from simple batch or lot information all the way up to full view of process activities that serialize down to the component level. This paper will review the need, benefits and system components of traceability and how it can be used to achieve a variety of business goals.

Why is Traceability So Critical?

Customer Expectations & Replacement

Customers expect to receive both quality and reliability in the product they ordered. And when the product fails, has unexpected flaws or doesn't meet their needs, a replacement is often covered by warranty or product recall at the expense of the supplier. When it comes to this cost, manufacturers frequently seek to share the burden with their supply chain partners. As companies realize the significant cost-savings driven from sharing the warranty or recall obligations, the pressure and scale of that arrangement will only increase.

Most established OEM brands have a legally binding supplier agreement that details the specifics of a supplier relationship. Those agreements typically include an “indemnification” or “liability” clause which outlines how the costs of recalls, warranties and other product-related failure activities are to be shared with the supplier. Standard industry averages estimate that warranty claims represent approximately 5% of sales in the electronics industry. However, these contractual agreements also include financial and legal responsibility for any product failures, intellectual property infringements, regulatory violations and many other liabilities. The scope of exposure that is assumed in that type of agreement is a significant business risk to be evaluated.

Productivity & Lean Challenges

While the need for traceability systems often stems from customer requests or contractual agreements, production teams also face increasing internal pressure to facilitate cost-reduction activities through lean manufacturing practices. To align with these efforts, manufacturers first need to identify areas for improvement, such as supply inputs, non-contributing processes and worker errors. Once these activities are complete, you are able to isolate root-causes in processes that can then be addressed with corrective action plans.

A traceability program provides the data needed to monitor and quickly correct previously undetected issues in production processes. This robust data has been proven to provide significant quantitative benefits – reducing manufacturing cycles, changeover times, and improving sales quoting, shipping, data entry and inventory management processes. Using this data helps uncover inefficient processes or repetitive work, leading to reduced waste, errors and non-value-added activities. Traceability systems that are implemented with a lean-initiative focus could result in nearly a 10% reduction in total product cost¹.

Early Detection of Defects

In an average surface-mount technology production line, there are over 800 million opportunities annually for process or component defects to occur². Whether the issue is driven from an engineering change order or an unexpected supplier defect, catching the error as early as possible is critical. By isolating the impacted components or finished goods prior to customer shipments, manufacturers can benefit from substantial direct and indirect cost-avoidances that justify the upfront investment of a traceability system. If defects are not detected until after customer shipment, most traceability systems will still allow for enough visibility to contain the risk to a smaller sample of finished goods. The importance of early detection is demonstrated by the estimate that product recall costs increase ten-fold at each step along the product lifecycle.

Regulatory Compliance

In today's competitive environment, manufacturers who sell into multiple vertical markets, such as aerospace, automotive and medical, are tasked with managing and meeting a variety of compliance requirements. In addition to customer expectations, manufacturers have to manage REACH, RoHS, ISO, UL and other governing bodies. Navigating the numerous regulations and requirements can drive considerable amounts of manual work and hard-copy documentation. Demonstrating compliance often counteracts lean manufacturing practices and also creates additional liabilities that are typically outlined in supplier agreements.

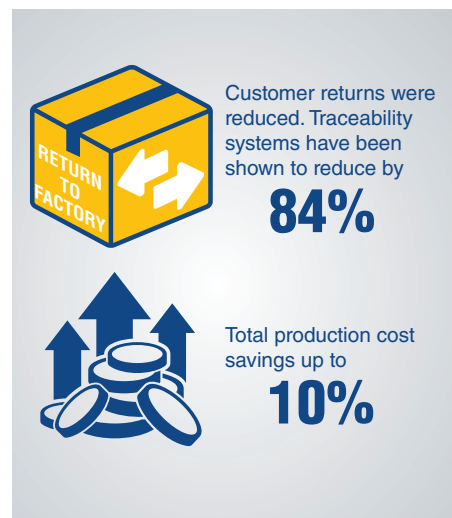
Utilizing data captured from production activities and supply inputs in a traceability system can provide an organization with a simplified process of aligning with and documenting regulatory compliance, and mitigating the possibility of violations. Whether it relates to conflict-minerals, process validation, containment or audit requests, implementing an effective traceability solution can reduce the time and resources needed to capture the data that various stakeholders have requested.

Four Key Benefits of Traceability

As manufacturers seek out traceability solutions, one of their primary concerns is often the return on investment. When it comes to value added from a traceability program, there are four key areas where manufacturers see the most benefits:

1 Production Efficiency

Typical cost structures in manufacturing environments show that materials comprise approximately 50% of the total cost. However, when you analyze that same data in the electronics industry, the material cost is typically closer to 80%³. Considering the importance of materials in the production process, manufacturers stand to benefit from faster access to more comprehensive data. This increased data effects productivity for electronics manufacturers in two main areas: error-proofing processes, and identifying and eliminating waste.



¹ Monette, F., & Van Bogart, M. (2009). *Track, Trace and Control; High Production Output at Low Costs*. Cogiscan.

² Monette, F., & Van Bogart, M. (2009). *Track, Trace and Control; High Production Output at Low Costs*. Cogiscan.

³ Monette, F., & Van Bogart, M. (2009). *Track, Trace and Control; High Production Output at Low Costs*. Cogiscan.

With a traceability system in place, manufacturers are able to monitor and detect any production problems or inefficiencies for significant process improvements. Simple enhancements, such as digital storage and access to documents, consolidating databases, simplifying expense and cost recovery systems, and automating manual processes, can have a major impact on overall production costs.

Leveraging traceability systems in lean manufacturing processes can help drive significant qualitative and quantitative improvements that impact profitability. Quantitative benefits can include up to 75% reduction in data entry time, up to a 32% reduction of work in progress and an 18% improvement in quality⁴. Traceability systems also provide qualitative benefits such as improved inventory accuracy, material and workflow improvements, reduced kitting errors and avoided supply shortages.

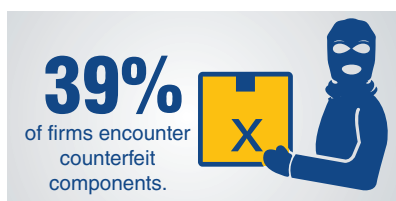
2 Warranty/Recall Purposes

Warranty expenses and liabilities are the most obvious consequence of a quality error that was not detected before end-use application. Defective components in the automotive industry are well documented due to the extreme cost and extent of impacted vehicles. Despite the fact that the automobile manufacturing industry generates over 1 trillion pieces of traceability data annually, however, it is estimated that only 20-30% of all vehicle components are actually tracked for regulatory and warranty purposes⁵. So despite several well recognized recalls, the industry can still improve its processes by using traceability data.

The automotive industry is not the only end-user market where defects have been identified as the cause of major recall efforts. Manufacturers of consumer electronics, appliances, medical devices and aerospace have all faced increased scrutiny over the integrity of their components and finished goods. Research estimates that consumer electronics manufacturers, communication carriers and retailers spent an estimated \$16.7 billion to process returned merchandise in 2011⁶. That same research indicates that 5% (or a staggering \$835 million) of that returned merchandise was a result of defective product. Given the numbers, even small, incremental improvements can have a considerable impact on warranty processing costs and overall profitability.

3 Counterfeit/Unspecified Supply Chain

Product recalls and warranties receive more attention than counterfeit or non-compliant components, but recent research suggests this issue is becoming a serious threat to supply chain integrity. A 2010 U.S. Department of Commerce study concluded that counterfeit incidents had increased over 240% during a three-year period. Included in this data are key findings that are believed to drive this rapid increase – poorly documented inspection protocols, inventory management and procurement practices, and a lack of dialogue along the entire supply chain (specifically insufficient traceability and accountability within supply chain organizations).



As the liability and exposure of product recalls expands through the supply chain, manufacturers will need to be more vigilant of their own supply chain. A traceability system will assist in managing any inbound inspection or supplier control protocols that support the production environment. The ability to track this data is vitally important to verify that the inputs into production are not deviating from standard acceptance specifications. This visibility is valuable in all customer segments, but specifically in the medical industry where a historical perspective of components is absolutely critical.

4 Regulatory Compliance

Electronics manufacturers face demanding environmental and process compliance obligations across all customer segments, regions and from OEM customers. Many of these regulations are a pre-requisite for selling into markets and customer groups. Demonstrating compliance is often taxing and inefficient, but a traceability system can dramatically simplify those activities.

⁴ Monette, F., & Van Bogart, M. (2009). *Track, Trace and Control; High Production Output at Low Costs*. Cogiscan.

⁵ Teradata. (2012). *Big Data Analytics: Unleashing the Value of Traceability Data*.

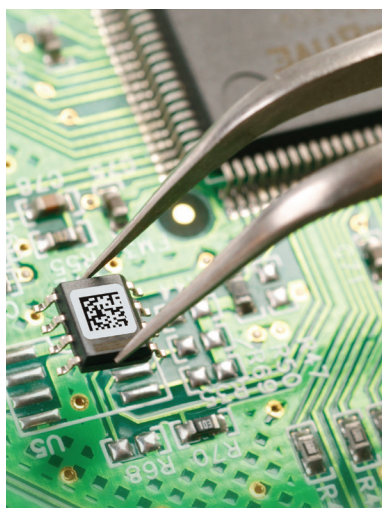
⁶ Douthit, D., Flach, M., & Agarwal, V. (2011). *A "Returning Problem"*. Accenture.

Environmental compliance is enacted by multiple key stakeholders, including government agencies, industry associations and OEM manufacturers. While there is some overlap between those parties, each layer presents additional challenges to electronics manufacturers. In Europe, for example, there are over 1,000 substances in 58 different categories that are regulated by REACH governance⁷. While only a portion of those substances pertain to the electronics industry, it demonstrates the sheer volume of monitoring that takes place globally. Samsung is an example of a proactive electronics brand that monitors and publishes substances that are banned, controlled, targeted or restricted.

Many large key vertical segments have strict business requirements that suppliers must comply with. The aerospace, automotive and medical industries all have their own set of compliance requirements that extend beyond environmental needs into process and quality-control activities. Similar to the needs captured within environmental regulations, these business requirements can be time consuming and manually intensive. Most programs are designed to help the collective supply chain achieve zero-defect rates and 100% on-time delivery targets.

Using manual and hard-copy documentation to demonstrate compliance with the myriad of regulations is time consuming and costly. Data from traceability systems can simplify and reduce errors associated with compliance requirements. The accuracy and depth of this functionality can be leveraged as an outright competitive advantage with over 55% of electronics manufacturers acknowledging compliance reporting as a major challenge⁸.

Considerations for Traceability Systems



While traceability systems improve manufacturing processes and prevent substantial recovery costs associated with product defects or non-compliance, the financial cost and value of implementing a system is an important business consideration. Thankfully, a wide-variety of options are available in the market today to meet the needs of manufacturers, ranging from the basic job- or work-order level that typically documents only the manufacturing site and date, up to serialized systems that capture full process and material attributes down to the production unit level.

When considering a traceability system, most manufacturers build their functionality based on three main factors:

- The amount of data desired to be captured
- How long the data will be kept
- How accurately the system needs to isolate corrupt processes or components

These factors help guide an organization when determining what investment is needed to reach your desired traceability goal.

Most tracing or tracking systems include three main components:

Hardware

Hardware ranges significantly in both capabilities and cost. Basic, entry-level systems require the lowest level of investment to implement, but are typically limited in their functionality. Speed, data storage, capacity and connectivity are important elements of a hardware system to consider when aligning your level of investment with the desired functionality of a traceability system.

Software

Software plays the most critical role in the overall traceability system, as it is the platform that bridges all input, process and output needs. Software is the tool that allows managers to leverage the data captured throughout the facility to improve quality, yield and compliance. As the pressure for mobile and wireless devices grows, software and cloud capabilities become more critical in supporting the traceability data requirements in production.

Marking Components

The final component of common traceability systems is the method of marking materials as they move through the production process. The three most frequently utilized methods are: barcode labeling, direct-marking and RFID active technology. Each of these methods provides application advantages and limitations that can be analyzed to determine which method best fits your financial and traceability needs.

Systems designed to provide full or total traceability offer a multitude of process and quality improvements driven from the documentation of six common assembly data points:

- | | |
|---------------------|---------------------|
| 1. Supplier inbound | 4. Final assembly |
| 2. Component | 5. Packaged product |
| 3. Sub-assembly | 6. Finished goods |

Data driven at these points can be then re-applied into analysis that provides value in the areas of focus previously outlined in this paper.

As customer and regulatory expectations expand, electronics manufacturers will be need to balance traceability needs with production costs to preserve profitability. The quantitative benefits discussed earlier in this document are intended to illustrate how traceability can have a positive financial impact on operations in spite of the increased liabilities facing product failures. Organizations that keep pace with the expanding requirements will realize both process improvements and continue to maintain many of the competitive advantages provided by traceability.

In Conclusion

As the requirements around industry regulations and costs of warranty/refund programs continue to evolve, manufacturers have much to gain from implementing a traceability system. Organizations are better able to compete and differentiate themselves by taking advantage of the direct and indirect benefits provided by a traceability system. Improving processes, controlling the supply chain, minimizing defect risk, navigating regulatory challenges and improving customer service levels are all accepted advantages of traceability.

The value gained combined with the risks and costs avoided by implementing a traceability system make it a key mechanism for a manufacturer seeking to improve visibility, efficiency and product quality. With a variety of investment levels available, a traceability system can be adapted to meet the scope and pricing needs of any size and mix of manufacturer. Most common traceability systems are implemented as a result of customer requirements, but the benefits go well beyond that need.

Brady's Background with Traceability

When it comes to traceability, Brady has a long history of providing label materials engineered specifically for electronic components. These materials are designed for high- performance environments that require durable, reliable, consistent and compliant solutions. Whether your manufacturing process incorporates hand assembly or automated assembly, Brady label materials are engineered to be a reliable element in an effective traceability system.

For more information on Brady's traceability solutions, visit BradyID.com/traceability.



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