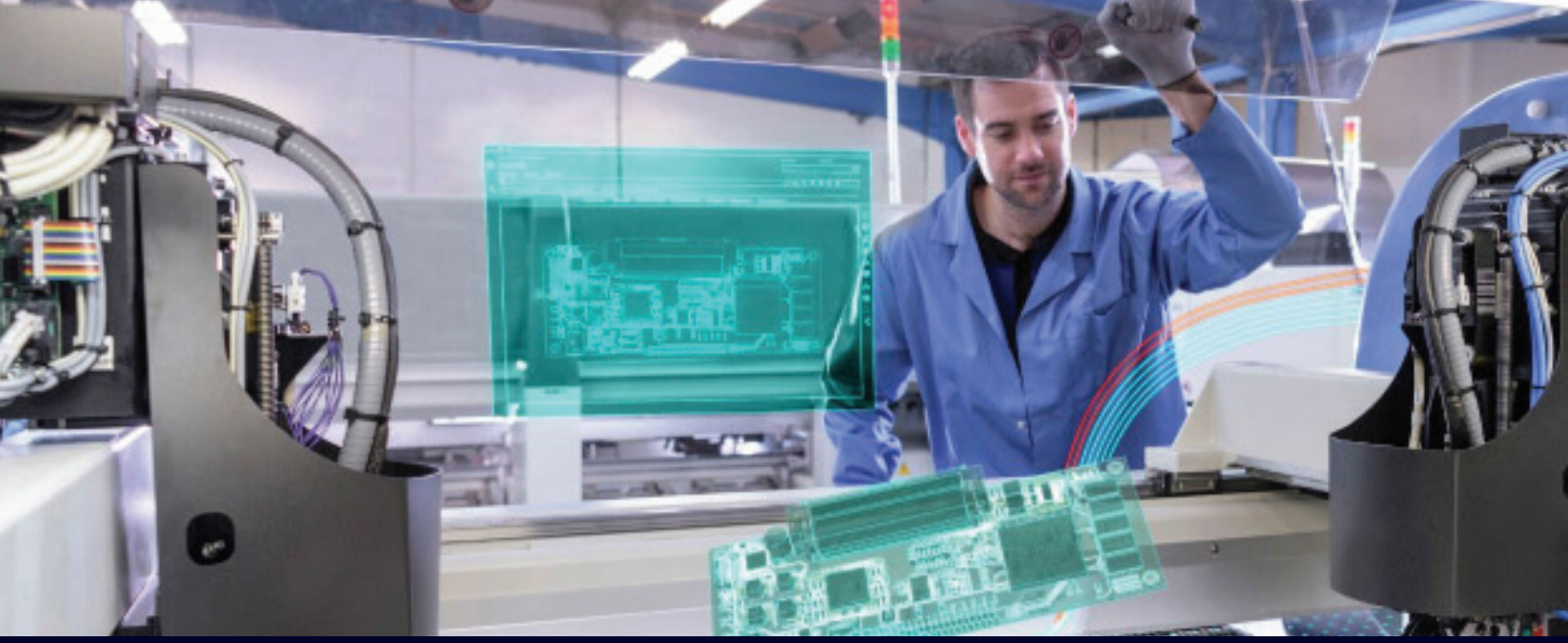


SIEMENS DIGITAL INDUSTRIES SOFTWARE

Achieving unprecedented components traceability, from warehouse to end-product, with predictive analytics

100 percent identification of counterfeit, refurbished, defective and malicious components with the Siemens-Cybord Predictive Analytics solution

Executive summary

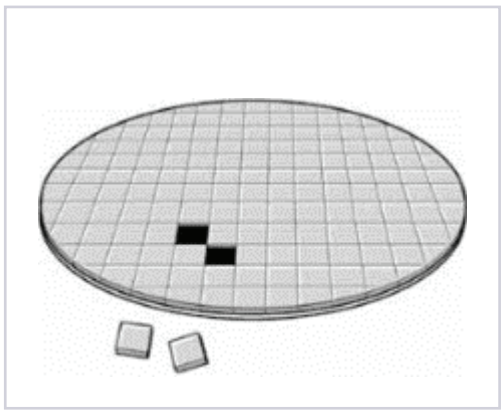
In PCB manufacturing, a single defective or compromised component can jeopardize an entire production run or worse, cause the final product to malfunction or perform unsatisfactorily, leading to product recalls. The sooner problematic components can be identified, the better. However, electronics manufacturers lack tools to effectively analyze and trace individual components used in the manufacturing process, and they rely primarily on costly and time-consuming sampling that does not provide actionable insights in real time.

The Cybord-Siemens solution addresses this crucial issue by providing an unprecedented level of component traceability using existing images from pick-and-place machines and advanced artificial intelligence, without the need for new hardware or changes to the manufacturing process. The solution gives electronics manufacturers enhanced transparency, excludes low-quality/damaged components upfront and reduces return merchandise authorizations by identifying problems before they occur.

The industry impact of compromised components

Experts estimate that as many as 10 percent of components in products on the market today are compromised. In some cases, the entire component is counterfeit and not provided by the origin vendor, and, in other cases, a product may contain mixed or non-homogenized reels of different components from the same vendor, expired components or components stored in improper conditions that affect the component functionality or quality. In extreme cases, components may have been tampered with intentionally and embedded with malicious code.

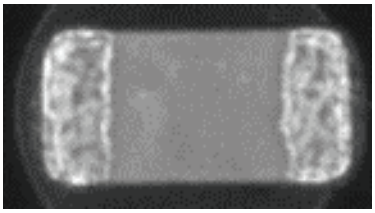
Compromised components have dramatic financial consequences. According to industry estimates, electronic defects are the cause of 0.5 to 2 percent of return merchandise authorizations (RMAs), significantly affecting electronics manufacturers' profit margins. The problem existed before the Covid-19 pandemic, but current supply chain issues have further exacerbated the issue. Unable to secure components from trusted suppliers on a timely basis, electronics manufacturers are forced to procure components from new and less-reliable sources. Now, more than ever, they need a way to monitor and trace component quality.



Counterfeit components: On the left - Forged age. On the right - Overproduced

Poor conditions / human error: Mis documented

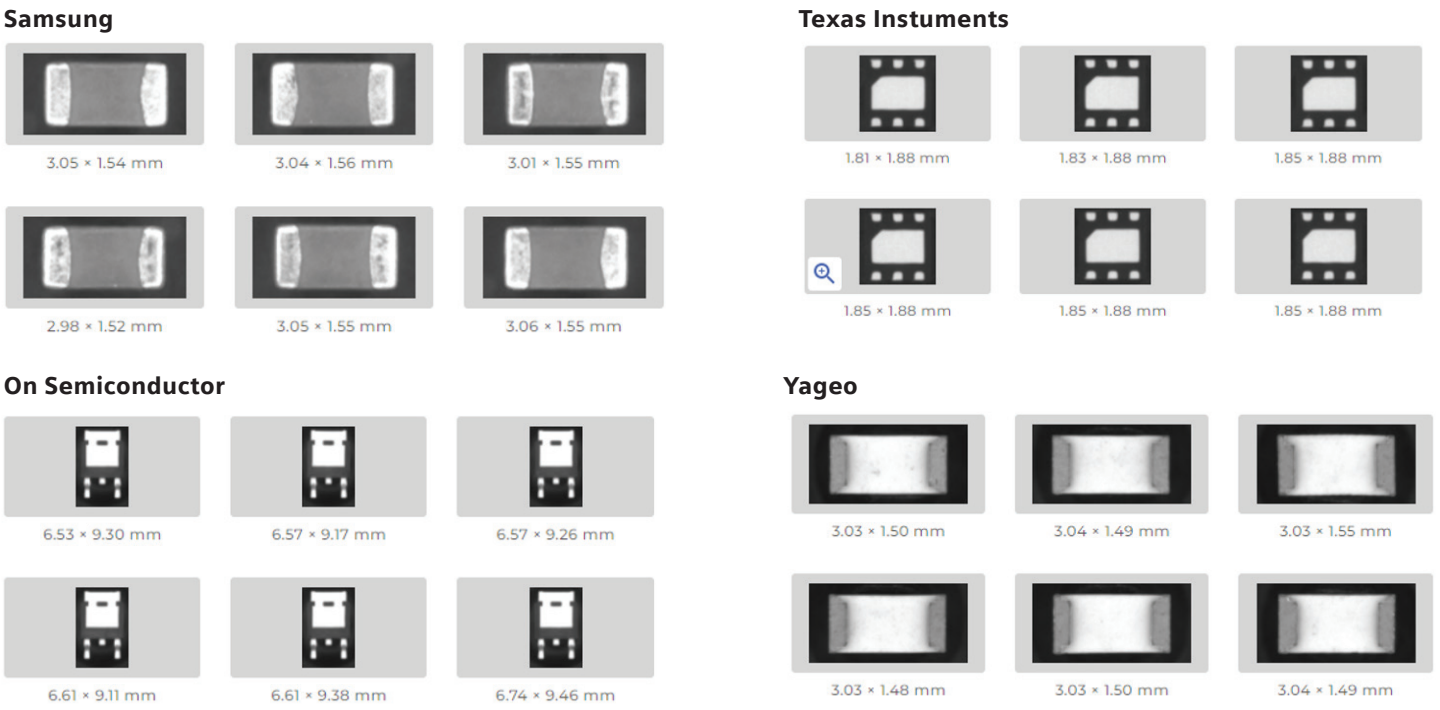
Defects



Oxidized leads

The challenge: testing individual electronic components

Although electronics manufacturers regularly use document management and workflow tools to trace the documentation of packages, those tools do not offer a way to check the individual components that make up the package. Manufacturers can test a small lot sample of components (usually three to five components per batch of 10,000) using detractive tests such as X-rays, chemical tests, soldering tests and electronic tests. However, lab tests are costly and time-consuming, and they don't provide information in real time. Furthermore, statistical samples cannot identify individual compromised components in a mixed source.



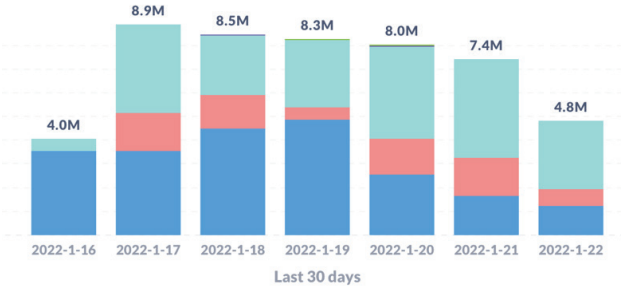
Identify manufacturer

Leveraging deep AI and computer vision for component compliance monitoring

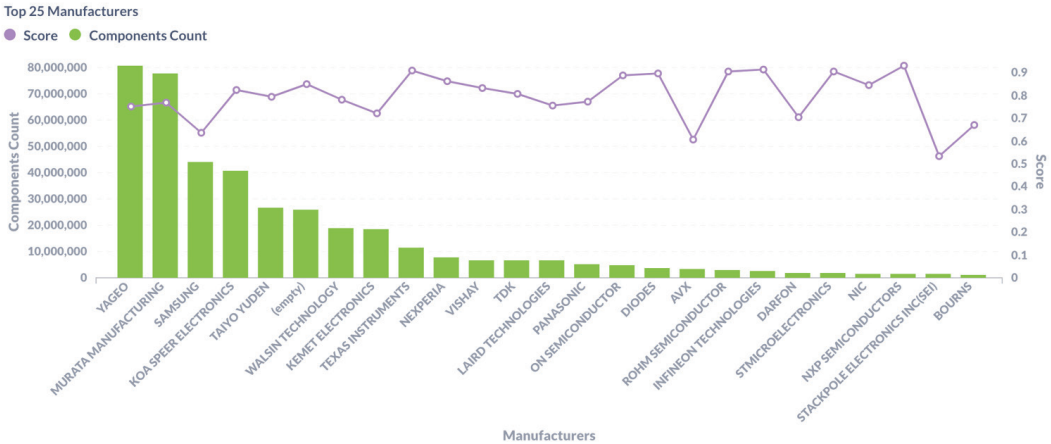
Surface mount technology (SMT) pick-and-place machines commonly use computer vision to modify the alignment of electronic components when they are lifted by a robotic arm. However, these existing bottom images are not limited to use in pick and place functionality and can be used for additional purposes.

In the Cybord-Siemens solution, the existing images captured in the pick-and-place machines are compared to a massive component library and knowledge database in the cloud. Using artificial intelligence (AI) models, the solution can verify component authenticity and identify damage and tampering in 100 percent of the components, providing lifetime traceability. Because the solution uses existing data, there is no need to introduce new operations or steps in the manufacturing process. The entire process is conducted while the SMT placement machine is placing the components using an application programming interface (API) that is compatible with any system manufacturing execution system (MES) products or data collection platform.

The solution is also available using a hybrid approach—on-premises in a factory along with a securely synchronized, cloud database. It is easy to deploy and begins generating reports right away to give manufacturers immediate value and full component traceability.



Production levels by components

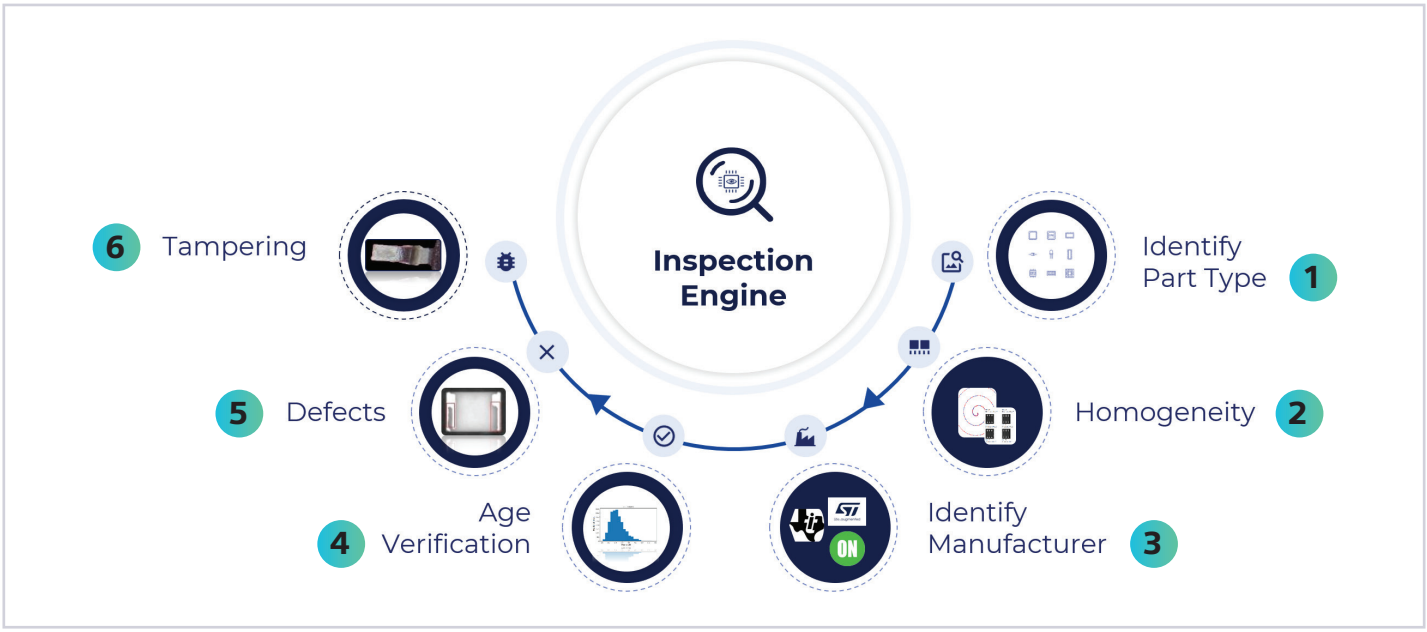


Component capacity and quality score

How online component inspection and analytics work

The previous section explained how images generated in the SMT process can be leveraged to verify component authenticity.

The below diagram represents the six steps through which each item is inspected and analyzed.

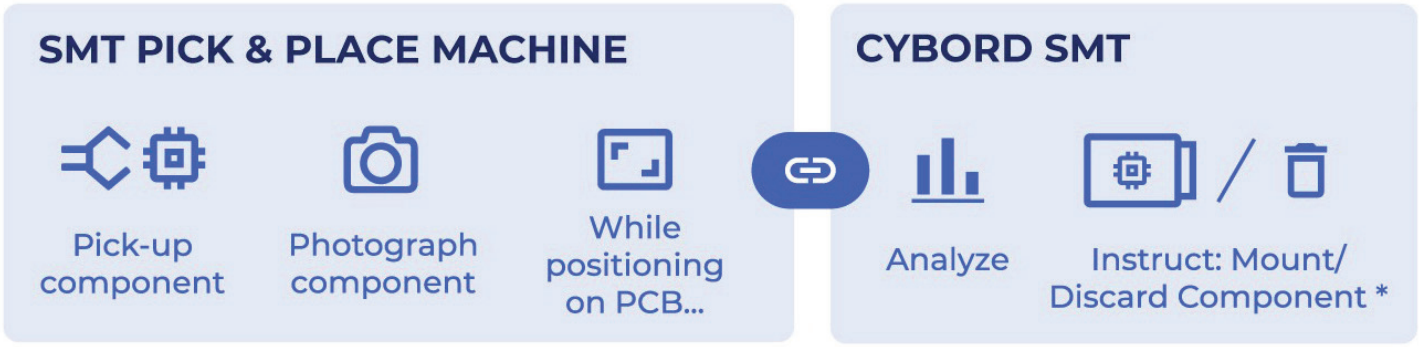


AI and big data analysis in under 100 microseconds

1. **Item identification:** The component is identified as compliant resistor/capacitor/IC packaging according to the setup documentation.
2. **Item homogeneity:** The solution verifies that all items in a batch are identical and there is no possibility of a mix.
3. **Authenticity:** The origin manufacturer is identified based on the packaging and the solution verifies that the component matches the manufacturer's documentation.
4. **Item age:** High-quality production items need to be in good condition for soldering, and documentation specifies age limits. The solution inspects the item and determines the age of the component.
5. **Defects:** The component is inspected for defects such as damaged pads and cracks in the packaging or twisted pads.
6. **Tampering:** All components should be new and untouched. The system detects any contact with the pads that may indicate tampering, for example, to refurbish a component or implant malicious software on it.

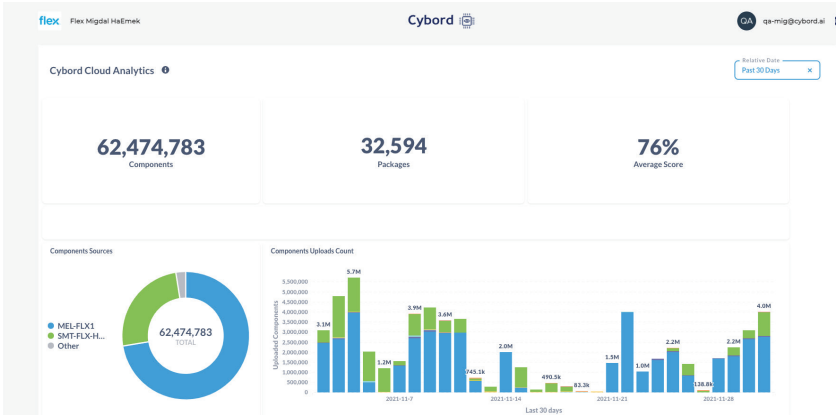
Once all tests are complete, each component is given a score of 1 to 100.

Flow diagram

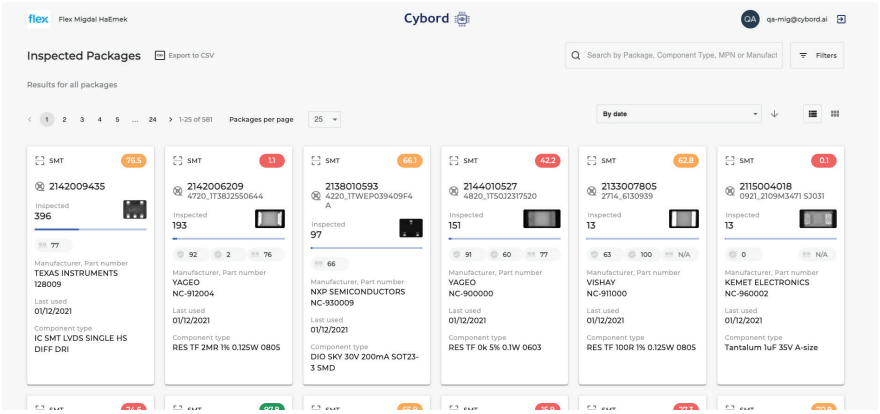


The Cybord workflow for component inspection and predictive analytics

Dashboard



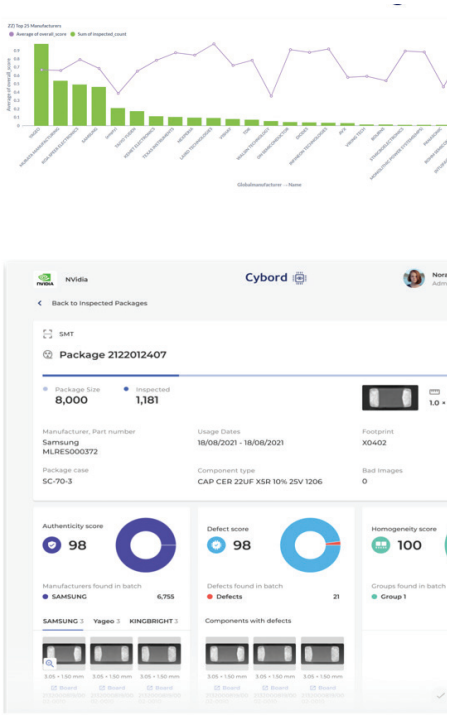
The intuitive Cybord dashboards



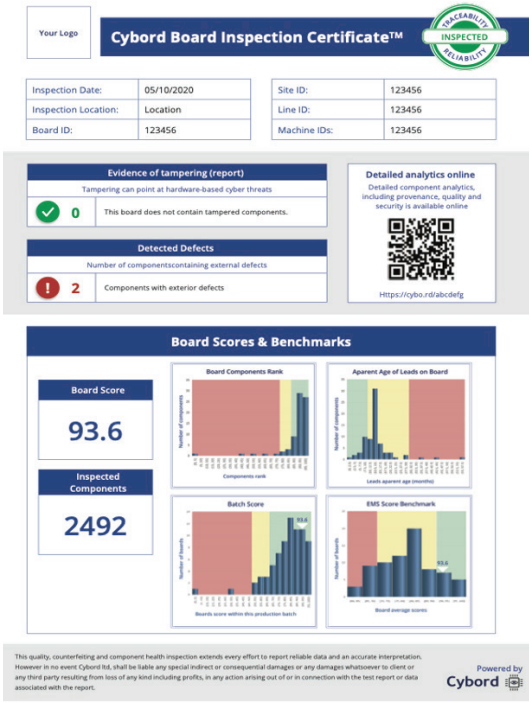
Reports and value for the customer

Cybord provides two types of reports: a board certificate report (see report 1.1 below) for original equipment manufacturers (OEMs) who manufacture the product and need full traceability for every assembled board; and a reel trace report (see report 1.2 below), to give the contract manufacturers that manufacture the assembled printed circuit boards (PCBs) full material visibility.

Supply chain analytics:
Reel inspection report



Production analytics:
Analytics dashboard

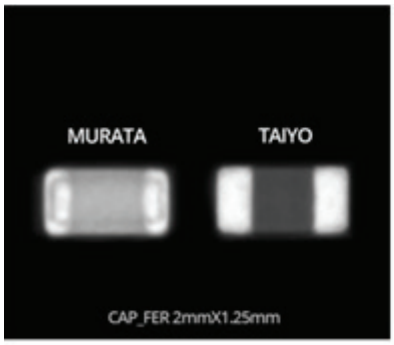


Acceptance & recovery:
Board inspection certificate

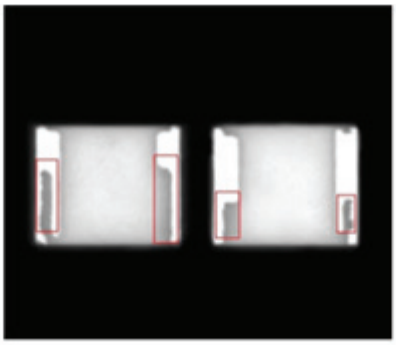
Examples of findings

The Cybord-Siemens solution detects varied types of problems in components, including those shown below.

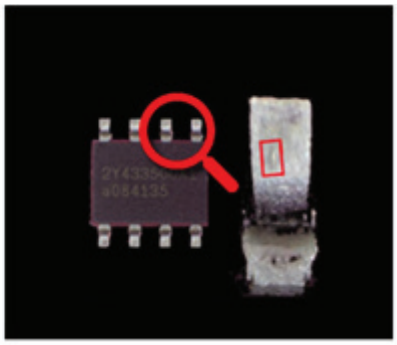
Mixed manufacturers



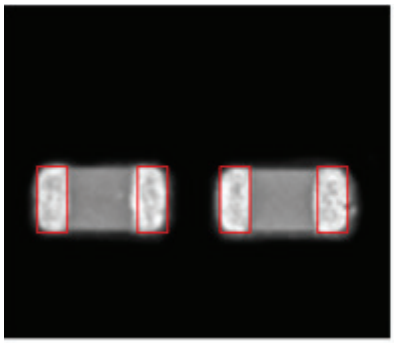
External defects



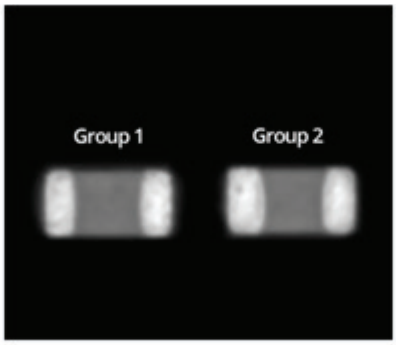
Reprogramming



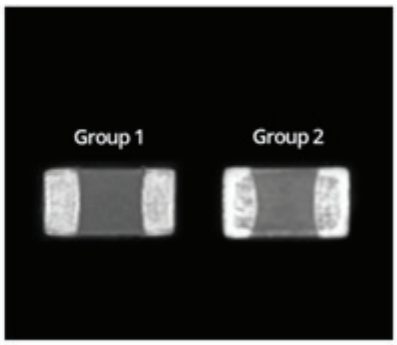
Solderability and age



Unauthorized splicing



Mixed lots

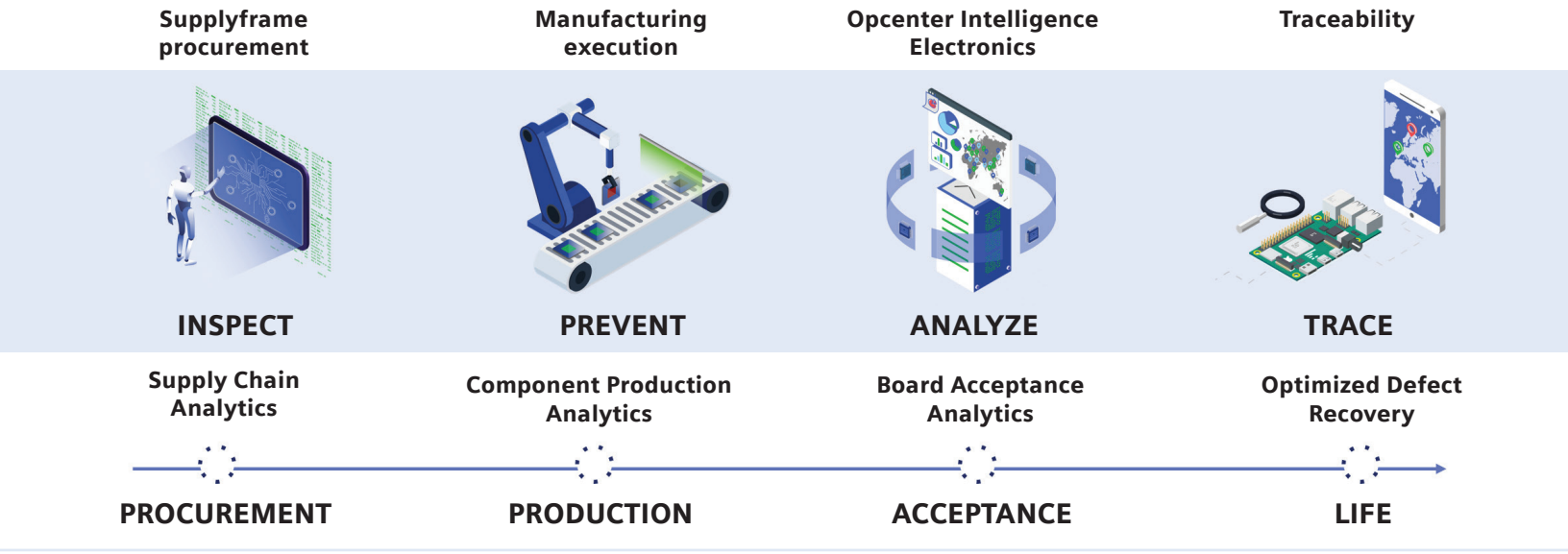


Problems found in components are identified and highlighted

Integration

The component analytics solution provides a deeper layer of quality control and analytics, drilling down to the level of the components placed in the SMT machine. The solution can be integrated as part of an MES system or as a standalone solution.

This unprecedented component traceability data is complementary to existing traceability systems and platforms.



Opcenter integration

Conclusion

AI can help improve quality and traceability in the production process, which is why Siemens promotes AI usage in production. The Cybord-Siemens Predictive Analytics solution uses AI technology and big data at the electronic component level, enabling an unprecedented level of traceability and end-to-end quality, from the warehouse to the end-product.

Siemens Digital Industries Software

Americas: 1 800 498 5351

EMEA: 00 800 70002222

Asia-Pacific: 001 800 03061910

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