Traceability for the electronics industry

Manufacturing execution solutions for global electronics manufacturing

Siemens PLM Software

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Siemens PLM Software provides a comprehensive composition of MES solutions for traceability, production control and enterprise integration to help ensure that cost and delivery targets are met consistently.

TECNOMATIX

SIEMENS

The business imperative for traceability

As outsourcing increases, brand owners (OEMs) are concerned about protecting their brand image. Electronic manufacturing service (EMS) providers need to address this concern by providing traceability information to retain existing customers and to acquire new manufacturing contracts. Environmental and safety legislation such as RoHS, WEEE and the Congressional Tread Act further compounds the need for traceability by forcing manufacturers to self-declare compliance and provide for traceability queries on demand. Traceability also helps to mitigate liability by reducing the extent of product recalls should any issues arise. Providing traceability offers manufacturers a significant competitive advantage by addressing overall customer, market and legislative needs.

Complexity in providing for manufacturing traceability

The dynamics of electronics manufacturing today is characterized in many cases by extremely short product lifecycles with high product mix running simultaneously on the shop floor. Miniaturization and constant developments in component technologies increase the risk of quality issues that may only be discovered later in a user environment.

Furthermore, legislative demands, such as lead-free assembly compels manufacturers to capture and retain shop floor events well after products have been introduced into the marketplace. In today's manufacturing environment, traditional means of performing traceability are no longer practical.

The types of traceability queries that will arise are:

- Was this product assembled with a defective component or process?
- Is the whole manufacturing order affected or is it limited to a specific component batch or lot?
- Was this product assembled with compliant processes?
- What is the overall production history of this board or box?

These types of queries can no longer be answered by manufacturing organizations using stand-alone shop floor systems since the number of event transactions on the shop floor has increased to a rate where traditional data capture is no longer feasible. The ability to capture exception events and integrated data sharing is a must to meet traceability requirements in today's dynamic production environment.

Covering all possible traceability requirements for electronics manufacturing

The Tecnomatix® Traceability software solution from Siemens PLM Software covers all possible traceability requirements for today's electronics manufacturers. From component level to full system build, manufacturers can perform full traceability queries on demand eliminating guess-work and ambiguity. Since our traceability solution is scalable, manufacturers can work with the Siemens consultant to select what level of traceability is required leading to a deployment plan that will meet specific organizational needs. Traceability coverage can begin with component to PCB board or extend throughout the production lifecycle to offer coverage for: materials, machine, process and full system build relationships.

Being specifically designed for the electronics industry, the Tecnomatix Traceability solutions offer significant competitive advantage to enterprises that need to protect brand equity and comply with a variety of environmental and safety directives. Whatever the requirement, Siemens provides manufacturers a nearly off-the- shelf trace-ability solution that can be configured to meet specific business needs.

Traceability solutions for electronics manufacturing

Traceability is a component of manufacturing execution systems (MES)

Today's production environment has substantially increased the number of issues that need to be managed in real time prompting the evolution of MES from primarily providing for quality assurance to covering nearly every issue of shop floor management. These issues include: managing materials in WIP to assure correct production setup; equipment utilization monitoring to maximize all production resource opportunities; production event capture for process control; route enforcement; repair management; overall visibility in real time to monitor and improve key performance indicators (KPI). Today's MES is a composition of traceability, production control and enterprise integration.

MES = traceability + production control + enterprise integration

- ***Traceability*** through real-time data collection during the production process and powerful reports through which this product and process information can be traced
- ***Production control*** by automating manufacturing rules and verifying processes to prevent deviation from planned processes thus dramatically reducing mistakes and enabling improvement of key performance indicators (KPI)
- ***Enterprise integration*** to leverage the return on investment from today's business applications

MES integration to ERP/MRP/PDM/order management and production planning applications ensures that these applications don't live in isolation.

Key benefits of Tecnomatix traceability solutions

- Minimize size of product recalls and internal reworks
- Satisfy customer and regulatory requirements quickly
- Manage new challenges like RoHS transition and WEEE quickly
- Expandable as the foundation for complete production control thus enabling improvement of key performance metrics

PROVEN RESULTS

"With more than 50 percent of planned orders between now and the end of 2005 requiring compliant parts, manufacturers must take action now to safely error-proof their processes while transitioning inventories and demonstrating compliance. MES applications that were previously viewed as nice-to-have for competitive advantage are rapidly becoming requisites for survival. Look to execution products from vendors with experience in the high-tech arena such as [Tecnomatix]."

Simon Jacobson
AMR Research

Component and board traceability

The Tecnomatix component and board traceability solution enables PCB assemblers to meet basic traceability requirements from mounted components through board and batch history. Beyond meeting the core traceability requirements, the solution allows manufacturers to verify setup, eliminating incorrect component mounting errors and providing full visibility to material locations in WIP for better inventory control. The solution can integrate with your PLM/ERP/MRP systems for BOM and material count synchronization and data retention.

Meeting traceability requirements for PCB board assemblers

The Tecnomatix component and board traceability solution traces board history down to the component level. The solution captures mounted parts including the vendor source; manufacturing batches and lots; and board mounting history by date, time and machine.

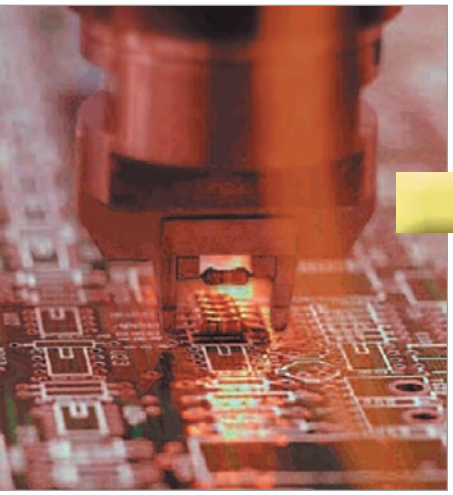
A comprehensive range of traceability queries are available including:

PCB	*Components*	*SMT line*
By serial number	By date code	By location
By product	By supplier	By time horizon
By revision	By kit	By customer order
By work order or lot	By assembly machine	By work order or lot

Queries are available on demand via web interfaces allowing manufacturers to extract data in logical formats that are recovered in minutes.

Providing business benefits beyond satisfying component and board traceability requirements

Inherent to the solution are functionalities for managing material locations and verifying kitting and SMT setup. This is a substantial benefit that will eliminate mounting errors due to human error associated with manual verification and production signoff. Furthermore, material locations are traced giving manufacturers real-time visibility to material levels in WIP. This provides inventory planners better tools to manage plant-wide component requirements and reduce inventory buffers to offset material count discrepancies. Better material management tools also give manufacturers improved flexibility in issuing parts to the shop with the ability to track locations against specific work orders.



Component and board traceability

Part verification system
Verify setup at kitting stations and on machines to eliminate part placement and build errors.

Material tracking
Real-time visibility of actual material locations in the plant and dedicated to WIP for vendor/lot traceability. Ability to synchronize with ERP/MRP systems enables more accurate material counts and component traceability.

Nearly out-of-the-box component and board traceability solution

The solution has been developed to be independent of machine types and is architecturally light being a web-based, point, scan or click package. Configuration typically focuses on factory workflow which is then defined in the system. The solution supports most common barcode label types, including: 1D, 2D and laser and utilizes the latest WIFI communication equipment.

Expandable to meet more advanced traceability and production management requirements

As part of the Tecnomatix MES solution for electronics, the component and board traceability solution is wholly expandable to meet the full range of MES requirements for electronics manufacturers including traceability for full system build, material management, lead-free assembly support, production monitoring, quality assurance and full enterprise visibility.

Key benefits of component and board traceability

- Minimizes scope and size of product recalls
- Accurately tracks manufacturing events by capturing all PCB assembly and inspection points
- Automatically associates specific suppliers > lots > date codes to PCB serial number thereby avoiding all guesswork
- Eliminates mounting errors associated with wrong part placements by verifying kitting and machine setup
- Gives instant visibility to material levels in WIP, allowing improved inventory planning
- Wins more business by complying with core traceability requirements

WIP monitoring
Board manufacturing routes are monitored and every pass of a WIP station is time and date stamped for process traceability.

Traceability reports
Perform web-based traceability queries by component, board level and SMT line history. Archive data for post-product traceability and to answer field queries.

Material traceability

With the onset of RoHS compliance by mid-2006 along with advances in component technologies, Siemens provides detailed material tracking and traceability to meet legislative and environmental compliance as well as eliminating risk of contamination of processes by noncompliant or over-exposed materials on the shop floor.

Facilitating RoHS (lead-free) compliance

The European Union's RoHS directive is the major driver of the industry's movement to lead-free assembly. During transition to lead-free, a number of anticipated issues are expected, from process management to production quality. One major issue is material management on the shop floor where a large number of part suppliers are expected to maintain existing part numbers thus creating confusion and leading to the risk of mixed components (compliant and noncompliant) being mounted on the same board. Furthermore, manufacturers will retain both leaded and nonleaded parts in their inventories while component suppliers obsolete their leaded catalog lines. This means that dual inventories and dual processes must be maintained. The contamination risk is real if a proper material management system is not in place. Lead-free assembly still has many unknowns; for example, issues related to metallurgical behavior may manifest itself well after production when the product is in the field. RoHS directives therefore require manufacturers to maintain production records for up to four years. Without automated tracking, providing for these traceability requirements will be extremely tedious. Siemens provides full lead-free support in the production lifecycle from material management through process control.

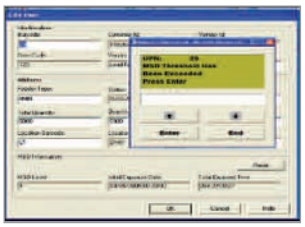
Handling and tracking MSD and other packaging technologies

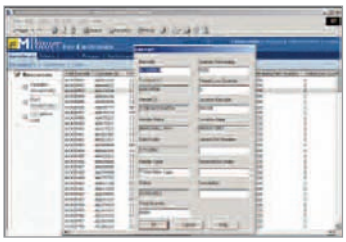
Further miniaturization along with shorter product lifecycles increases the challenges in handling different component packaging technologies.

Introducing moisture sensitive devices (MSD) presents a range of complexities to the shop floor that is expected to increase with more miniaturization and migration to lead-free. Packaging technology advances occur within shorter durations, meaning operational issues may only be known at the field level thereby increasing warranty services. The ability to track specific component and package types allows manufacturers to: consume materials before exposure expiry (for MSD); purge contaminated materials in WIP; and track specific vendor and packages to specific product builds in case of an increase in field failures and warranty claims.

Key benefits of material traceability

- Supports lead-free assembly by distinguishing between leaded and nonleaded components, assuring that the correct components are allocated to the correct process and by providing post-production traceability as demanded by the RoHS directive
- Manages exposure time of moisture sensitive devices (MSD) and tracks material locations in the event of an alert, including material purging when appropriate
- Provides full traceability for component related queries, reducing the scope of recalls and warranty service provision





Materials traceability

Manage leaded/nonleaded components on the shop floor *and tracking locations despite part-number commonality. Assure that correct components are allocated to the correct processes.*

Moisture sensitive device (MSD) management *by timing exposure thresholds and alerting before thresholds are exceeded.*

Full material traceability *enables contaminated and noncompliant materials to be located and purged before assembly.*

Process traceability

Process traceability enables manufacturers to provide traceability for specific production events including part and process changes introduced on the shop floor. This includes any defects captured and the associated repair processes along with operator activity and SMT machine events including placement by reference designators. Providing for process traceability together with material, component and board level traceability allows manufacturers to achieve full traceability thereby significantly reducing the scope of potential recalls while meeting nearly every possible traceability requirement for PCB assemblers.

Tracing changes on the shop floor

Frequent changes are now standard on the shop floor, whether these are to the job (i.e. a revised BOM) or changes with part replenishment (i.e. from different lot or alternate part number). Capturing such process and part changes is critical for accurate post-production traceability.

Capturing defects and repair history

Logging discovered defects against boards at time of inspection and test provides users the means to trace possible root causes – particularly if the cause is a component failure from a specific vendor or production lot. Furthermore, capturing all repair events is critical in assuring traceability for environmental and safety compliance. For example, assuring that only lead-free components were used during rework is a factor in declaring RoHS compliance. Besides assuring that compliant parts and processes were performed during repair, manufacturers will also need to trace operator certification confirming that only certified operators with the appropriate skill and training performed the necessary repairs. By tracing defect and repair histories, manufacturers can perform traceability queries against defect root causes such as a defective component or process. By performing defect and repair traceability, the scope of potential recalls and warranty services are significantly reduced.

Tracking SMT machine events activity

Capturing machine events allows manufacturers to trace machine related defects such as inverted or missing components including tracing placement to the reference designator level. Machine interfacing also offers manufacturers the additional benefit of automatically aggregating machine events into OEE (overall equipment efficiency) reports for improved line utilization. Furthermore, interfacing enables an automatic stop should there be any setup error where corrective action was not taken.

Key benefits of process traceability

- Provides a truly accurate traceability solution by automatically logging all change management events including part replenishment from different vendors
- Significantly reduces recalls by offering visibility into root causes of product and process defects by providing comprehensive board history including test results and which repair activities were undertaken, such as replaced parts and operator activity
- Enables highly detailed traceability by integrating with machine environments allowing tracing by reference designators and mounting errors

Process traceability

Change traceability for tracking changes
on the shop floor, including introduction of BOM revisions, new parts and on-the-fly changes (including alternate part numbers).

Defect and repair traceability
by logging all process events including capture of defects at the board level with repair routes undertaken such as replaced components and operator activity.

Machine performance traceability
by capturing machine events, (including machine/feeders used during mounting process), errors during mounting, verification that process is performed as planned and tracking components mounted to the reference designator level.

Box assembly traceability

Box assembly traceability provides final box assemblers a total traceability solution for full system builds. All aspects of the box build process are captured including: genealogical (parent/child) relationships, route tracking, repair process traceability and change management traceability. The box and board level traceability solutions provide electronics manufacturers end-to-end traceability coverage.

Providing genealogical traceability

All aspects of the parent/child relationships are captured from BOM to PCB to box assembly. Integrated with board-level traceability, manufacturers can perform virtually any component and subassembly traceability query.

Capturing assembly routes

Capturing WIP progress is performed both passively by automatic scanning at selected WIP points and actively by operators when performing specific tasks. By capturing routes, manufacturers can trace activity to specific locations, including operator activities, allowing identification of specific lots/batches should field issues arise.

Capturing repair history

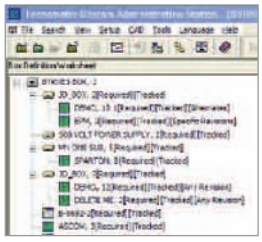
By capturing box repair history, manufacturers can trace operator activity to make certain that the correct sequence of events was followed during the disassembly and reassembly, while also confirming that the right subassemblies were used.

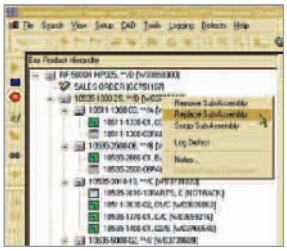
Capturing engineering change order (ECO) introductions

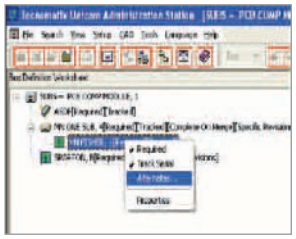
As with board-level traceability, by capturing changes introduced in production via BOM revision or alternate parts and processes, manufacturers will ensure that their traceability efforts will be complete.

Key benefits of box assembly traceability

- Provides complete traceability from component level to subassemblies to final system build
- Captures all routes for process traceability
- Assures that the correct sequence of events and components were used by capturing all repair activities, allowing tracing of disassembly and reassembly processes
- Provides highly accurate box build traceability by capturing all ECO introductions







Box assembly traceability

Build genealogy
captures all relationships in a full system build from BOM to PCB to final box build.

Route traceability
by time and date stamping the box assembly progress in WIP.

Repair traceability
captures all repair activity and assures that disassembly and reassembly was performed in the correct sequence of events with the correct subassemblies and components.

Tracking changes
captures all ECO changes and allows users to make certain that changes followed the correct sequence of events and included the correct subassemblies and components.

Tecnomatix for the electronics industry

Electronics manufacturers must bring cost-effective products to market faster than ever while meeting a variety of challenges including the introduction of a large number of new products in record time; manufacturing a growing mix of complex products; meeting customer and regulatory demands like traceability and lead-free manufacturing; and introducing new technologies, components, software, equipment or processes.

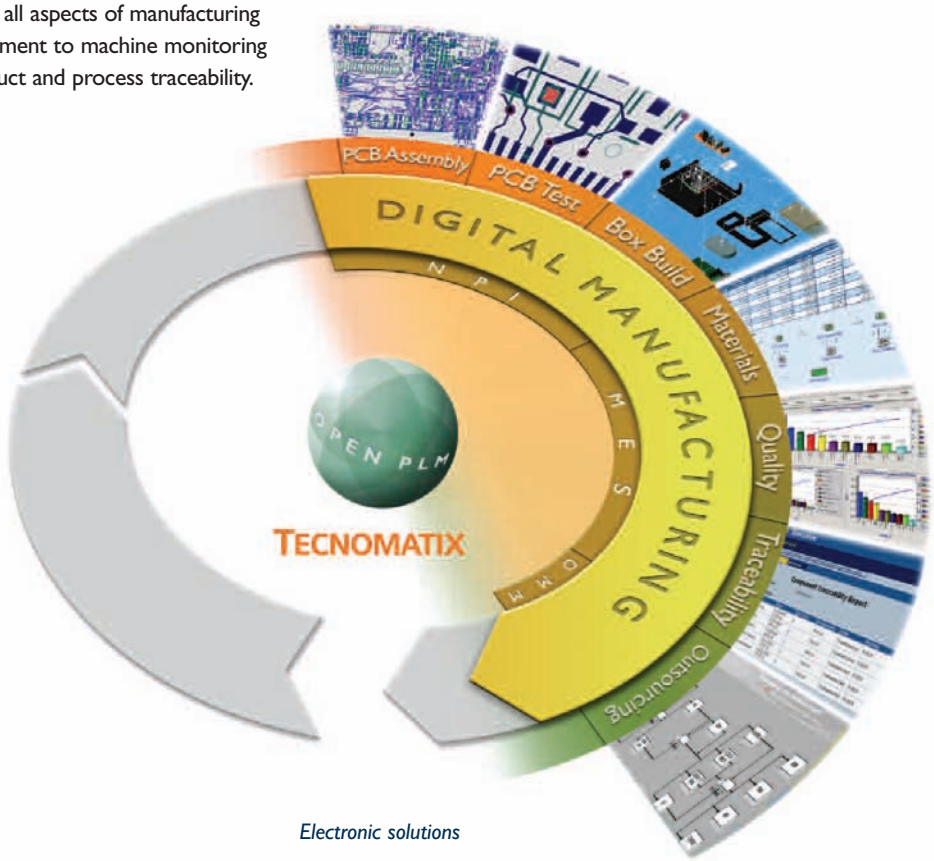
Beyond these day-to-day manufacturing challenges, global electronics manufacturers face the challenge of acquiring new facilities; selecting the right equipment; balancing the workload between factories; managing inventory and quality on a global scale; and managing the outsourcing business process.

Tecnomatix for electronics solutions addresses these critical issues by providing the most commonly used digital manufacturing solutions for designing, managing and integrating the NPI process, production execution on the shop floor and the outsourcing business process at the single plant, corporation and extended enterprise levels.

Use this complete, end-to-end manufacturing solution to design, optimize and execute board- and box-level production processes. Tecnomatix helps you introduce new products faster by more easily programming and optimizing the widest variety of assembly machines and test equipment in low- and high-mix scenarios, logging defects in the repair process and managing all aspects of manufacturing execution – from material management to machine monitoring to quality management to full product and process traceability.

Tecnomatix enhances your enterprise competitiveness by allowing you to:

- Get the NPI process right the first time
- Optimize throughput even in high-mix conditions
- Cope effectively with change
- Tighten your grip on shop floor execution
- Minimize size of product recalls and internal reworks
- Analyze production information and get to the root cause of issues in real time to prevent mistakes from eroding your cost margin
- Meet ever growing customer and regulatory demands
- Streamline the OEM-ODM/EMS/CM outsourcing business process



Electronic solutions

Global professional services

Maximize the benefits of your Tecnomatix solution

Siemens offers customers much more than depth of expertise. We take great pride in our ability to deliver the highest level of professional services so that you can achieve maximum benefits from our Tecnomatix solutions in the shortest possible time.

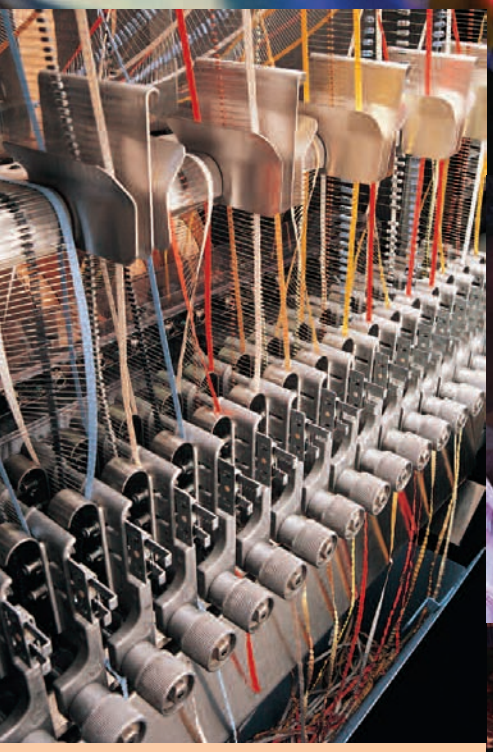
Whether you face challenges at home or in a remote part of the world, Siemens has the flexibility and the people in place to respond. Our professional service experts share vast experience and business knowledge in project implementation, project design and project methodology. They are your experts in Tecnomatix MPM technology.

We are ready to help you achieve maximum impact on your business processes by providing end-to-end MPM solutions matched with consulting, development, implementation support and engineering services that fit your environment and objectives.

Prepare, predict, perform better manufacturing processes

The Siemens professional services team can help you to:

- Maximize market potential for your products
- Optimize and manage global distributed manufacturing
- Respond quickly to new market opportunities
- Accommodate frequent changes in where and how you produce, as well as what is produced
- Deliver speed and flexibility across the extended enterprise



About Siemens PLM Software

Siemens PLM Software, a business unit of the Siemens Industry Automation Division, is a leading global provider of product lifecycle management (PLM) software and services with 5.5 million licensed seats and 51,000 customers worldwide. Headquartered in Plano, Texas, Siemens PLM Software's open enterprise solutions enable a world where organizations and their partners collaborate through Global Innovation Networks to deliver world-class products and services. For more information on Siemens PLM Software products and services, visit *www.siemens.com/plm*.

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