

Disk Drive Manufacturers Move Ahead with RFID-Enabled Media Manufacturing

The world's disk drive manufacturers are positioned at the heart of today's information-centric world. Throughout their history, disk drive manufacturers have successfully relied on a strategy of ownership and vertical integration of key underlying technologies: designing, developing and producing the components that underpin its storage products, rather than relying solely on outside suppliers.

In order to respond quickly and intelligently to the rapid changes in the industry and to deliver new storage products rapidly to a price-sensitive consumer market, disk drive manufacturers are always looking to optimize their manufacturing operations and gain visibility into the internal supply chain. This visibility additionally affords improvement in the utilization accountability of process tools, highlights process improvement opportunities, minimizes manufacturing rework and automates line processes.

Maintaining a leading position in the highly competitive hi-tech manufacturing market demands continuous improvement within manufacturing operations. Increasing production yield while reducing scrap has a direct impact on customer satisfaction by accelerating demand fulfillment capability and supporting competitive market pricing. Their top most priority being:

To Increase profitability and supply chain efficiency

- Driving to improved production yields in a high-volume, mixed product manufacturing shop floor
 - Material consumption (raw in, WIP, finished out)
 - Material containment (defects by process)
 - Key process indicators (labor, run rates, WIP tracking)
 - Movement of material (raw to WIP to finished good inventory) with verification

To Improve quality

- 6 Sigma quality control capability through measurable metrics

Media manufacturing process

Manufacturing hard disks is a complex process that encompasses numerous steps that convert aluminum blanks into high density data storage media that are used in hard drives. The manufacturing operations are typically performed within clean room environment with material flowing through manufacturing processes that use liquid chemicals and high temperatures.

Media and magnetic drive manufacturing consists of many process steps that can be grouped into five major categories.



Disk drive manufacturers require that every media disc that goes through each process be validated against different manufacturing criteria to ensure that the right operation is being performed on the disc, by the right tool and has the right pre-processing (recipe) conditions. These processing rules typically need to be performed in real time at every station and the results recorded for historical analysis and on-spot decision making prior to routing the media to the next operation.

In order to achieve end-to-end manufacturing traceability Work-In-Progress (WIP) information like the lot number, cycle time between processes, media carrier routing and resources used for every carrier under operation need to automatically captured and stored

In the past drive manufacturers have migrated from using paper notes for WIP tracking to manual input terminals located throughout the process line. The manual stations were prone to inaccurate data capture as input accuracy was often lost due to operator (human) input errors. Recent experiments with barcode technology have not provided optimal traceability as the labels could not reliably survive the processing steps .

RFID and automated data capture

RFID can provide automated data capture at the time of processing. This data capture could include maintaining historical WIP information within the media to accelerate validation at the process stations. Typically automated data collection solutions include:

- RFID readers that could communicate and control the tool operations
- RFID read/write tags that could be embedded into the media carriers and can handle harsh processing environments. These tags retain processing information that can be read easily among different plant locations and vendors.
- WIP application that could enable their current processes with RFID and manage the WIP data between their enterprise systems and the factory floor operations

How RFID can help resolve ‘Pain Points’

RFID enabled media carriers currently being used by several manufacturers provides real-time data and complete process traceability that resolves the following ‘pain points’.

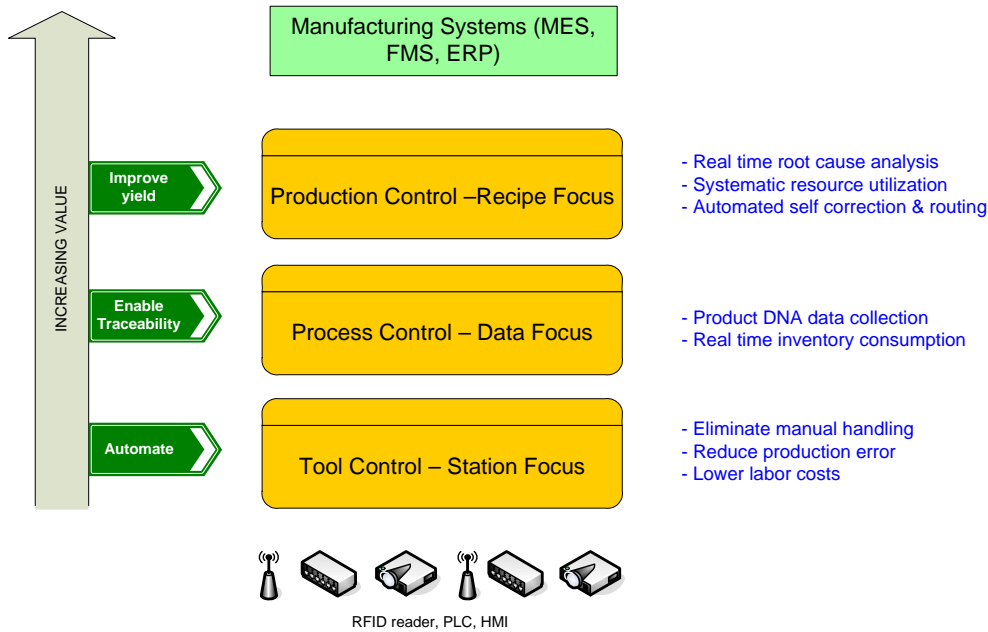
1. Process bottlenecks. Real-time data from RFID enabled processes allow plant managers to know precisely where each bottleneck is and what the real capacity is at that point. This information is critical for efficient planning for capacity upgrades and daily manufacturing operations.
2. Quarantines. Minimizing the financial loss caused by process upsets, flawed raw incoming materials and even post sale recalls such as Dell Computer’s recent ‘exploding battery’ recall. Having critical details of how every part is processed tucked safely away in a database can save huge amounts of money when these manufacturing crises occur.
3. Process optimization for yield. Often the final test yield/sort is the final arbiter of process yield. With detailed information on high yield parts processing history,

processes can be ‘tweaked’, high/low yield process tools isolated and the continuous improvement programs moved forward. The process data stored in RFID enabled media carriers provide the common thread tying final test yield back to each process step.

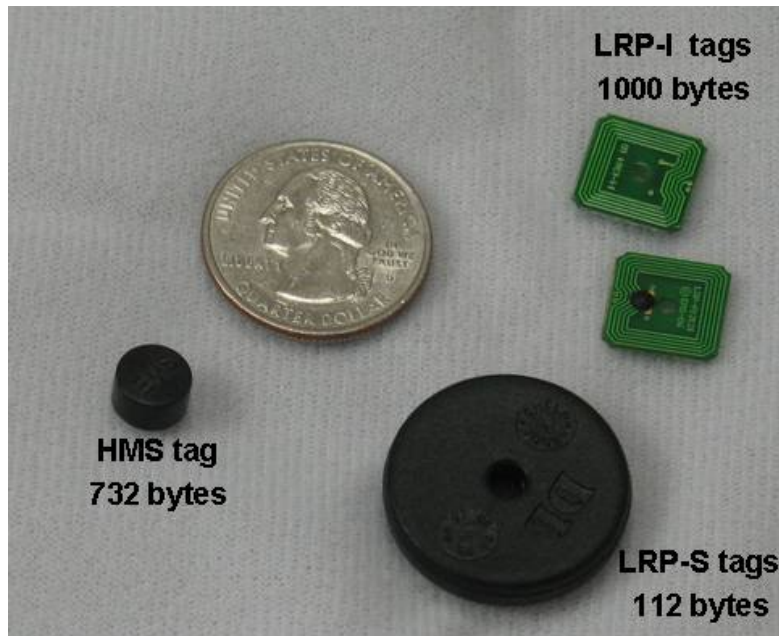
4. Mis-processing. Real-time automated decision making based on the data stored in each RFID enabled media carrier prevents mis-processing at each decision point preventing lost product due to mis-processing.

Developing a Scalable RFID based WIP tracking solution

Escort Memory Systems (EMS) and KeyTone Technologies have developed a comprehensive WIP tracking solution that combines RFID hardware and WIP tracking software. This solution has been deployed and tested within real time manufacturing environment and provides manufacturers with real time control and information that helps increase both throughout and yields. The unique solution helps operations managers track the material flow, identify process bottlenecks and monitor reject rates. The WIP solution supports configurable tolerances and validations and provides granular control over data collection and storage.



Solution Component: RFID Read/Write Tag



Escort Memory System's HMS and LRP-I tags are used extensively by media drive manufacturers. These tags are small (the size of an 8mm button) with large re-writeable memory areas most suited for industrial application and capable of surviving harsh processing environments. These tags are embedded into each cassette and are capable of storing up to 1000 bytes of user data. Read/write operations can be reliably performed at a range of 18 mm or more while typically surviving several thousand cycles of use.

The tag data on each cassette typically holds lot information, routing information and WIP data in defined areas described by a tag memory map. At the beginning of every process, readers read these data sets and pass it to the local WIP software interface for processing instructions. On every successful process completion the tag is updated with new WIP data from that process.

Solution Component: RFID Reader and Antenna

Escort Memory Systems' HF-0405, HMS 827 and Cobalt HF integrated reader/antennas are used in disk drive WIP solutions.. These RFID readers are configured to take action based on the PLC (Programmable Logic Controller) triggers. For instance, a reader is triggered to read/write to the tag only when a new media carrier enters the tools.

The HF and HMS reader's small form factor allows them to be easily mounted on the tool at the entry and exits points of each processing station where data can be reliably read and written to the cassette tags. Cobalt HF readers larger form factors allow reading and writing at greater distances when required.

Solution Component: WIP Application

KeyTone has developed a WIP solution to integrate and process data from both RFID and PLC sensor devices. The solution includes workflow definition, integration of RFID data to external MES systems and custom data validation definition.

KeyTone Technologies (Confidential)

The KeyTone solution included the following software components:

Business components

- Process traceability –manages product history and validations through data on the RFID tag
- Product validation – sets up verifications and alerts based on defined process types, route and time
- Process containment – sets up business rules to manage throughput and product routing

Technology Components

- Device management – console to manage multiple RF and IO devices that might be integrated within process tools on the factory floor
- Data collection – data retrieval from PLC's, serial devices including barcode printers
- Enterprise Integration – Customized integration components to publish and synchronize data with Factory Information Systems (FIS).

RFID Solution Benefits

The implementation of RFID can rapidly demonstrate significant improvements in yield through the reduction of manufacturing bottlenecks and provision for preventative actions. The RFID system can automatically alert production floor operators and supervisors when quality measurements are outside of manufacturing specifications leading to immediate corrective action that could eliminate redundant processing and reduced scrap. Tool downtime tracking through system dashboards can rapidly identify manufacturing bottlenecks while providing maintenance supervisors with real-time information on machine status

The solution provides tangible benefits that include:

- Real time visibility into the internal supply chain
 - Increased revenue and profit potential through enhanced visibility of the entire production process
- Reduction in material variances
 - Source of the variance was immediately visible with shorter reconciliation times
- Detailed product traceability
 - Tying specific material lots to production orders helped determine cost immediately
 - Defect exposure was significantly reduced with traceability to the exact impact areas
- Significant reduction in labor retraining and management

- Improved processes identified the most effective and automated routing of products and activities with minimal impact to labor
- Enhanced employee productivity through employees being freed from manual product-tracking tasks to focus on value-added manufacturing activities