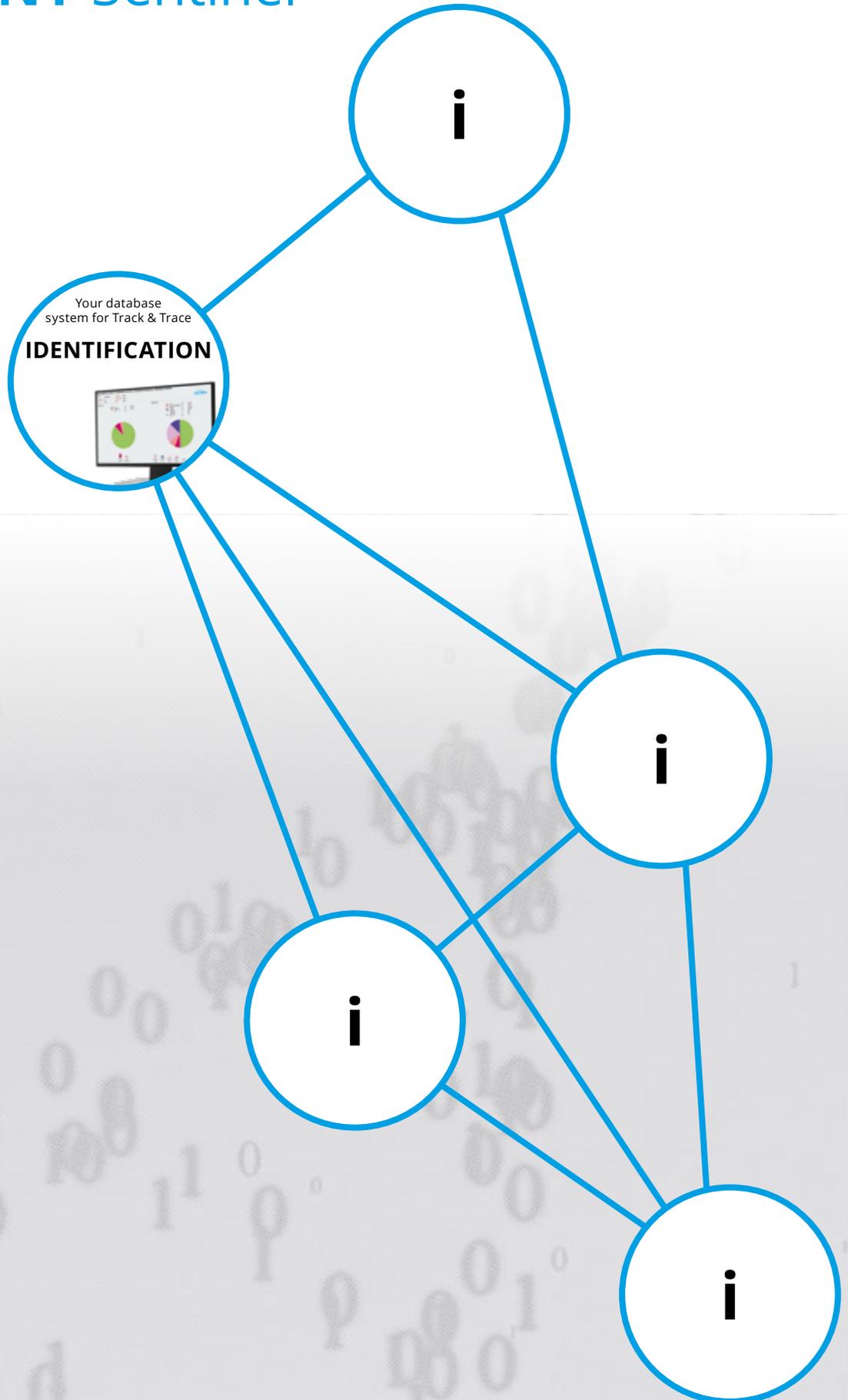


CURRENCY PAPERMILL SOLUTION

HARMONY Sentinel

A CASE STUDY



To meet the challenge of the marking of unique sheet ID's onto currency paper and subsequent tracking of the material as it moves through the various production processes within the papermill, Zeiser has the ideal solution, **Harmony Sentinel** is Zeiser's real-time workflow and database management system that provides 100% traceability and complete product history.

This case study gives an overview about the ECB accredited **Harmony Sentinel** solution installed in a high security environment for banknote paper production.

The **Harmony Sentinel** system is installed at a leading Italian currency paper producer to mark and track banknote paper production from the paper machine through to palletization. The solution consists of a server with a central Microsoft SQL database, Dual **Harmony Sentinel** Servers for system failover and multiple clients for the various production tasks in the production areas. Each client has the relevant hardware attached for the process step, such as handheld barcode scanner, label printer, cameras and machine mounted barcode readers to allow for the capturing of all relevant data and to assist the operators in performing the required production tasks.

The customer required an efficient and on-time solution to enable them to manage the production processes while keeping full records of each production stage along with a seamless integration to their existing ERP system.

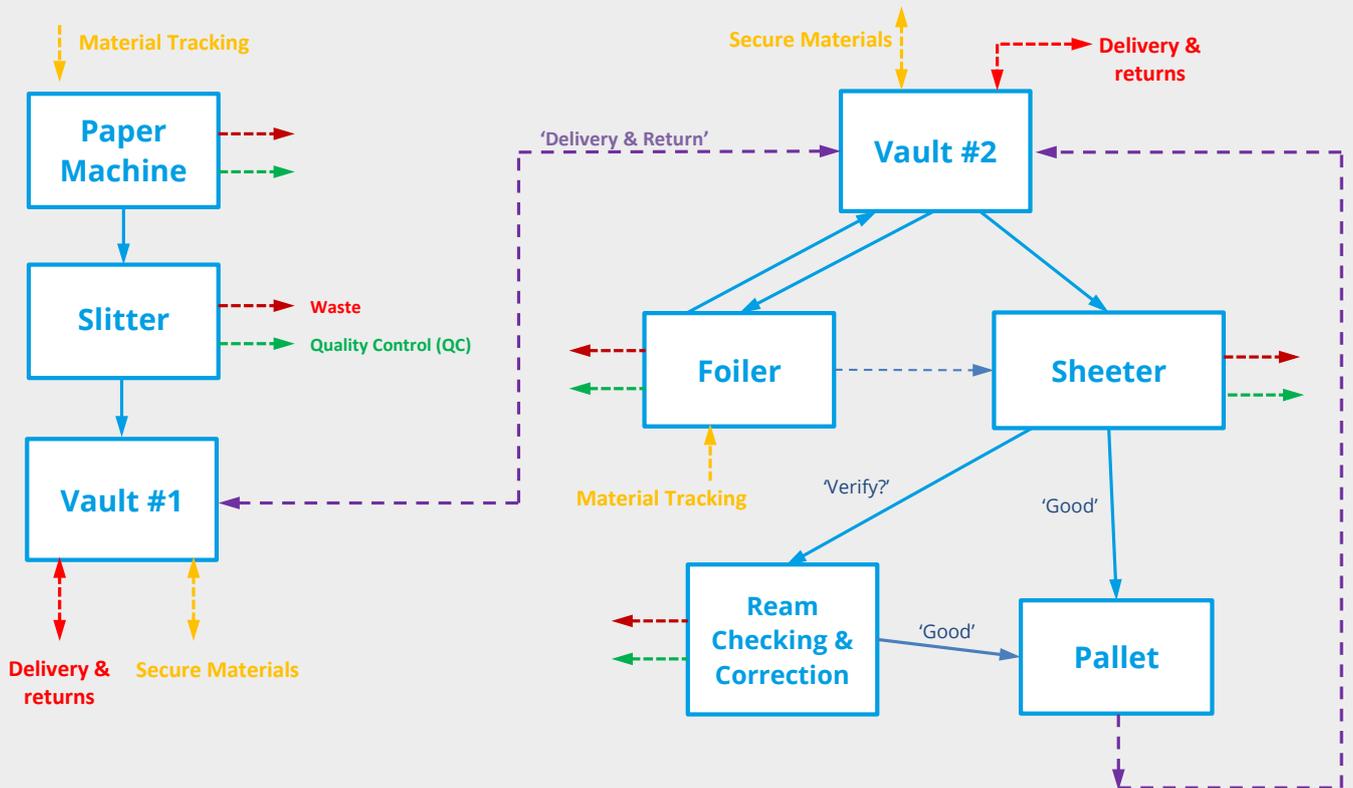
The **Harmony Sentinel** solution uses a core software framework, which allows for rapid configuration and development of the custom and defined software features required for the customers exact production needs using a modular approach. This includes custom graphic user interfaces that provided operators with the required tools and displays to allow them to undertake their tasks quickly and effectively.

By using the Control Room application, user management, roles and responsibilities could be easily defined. This approach also allowed for configuration for some strategic and secure processes to require 4 or 6 eyes authentication so that the customer has full control over the entire production workflow. The **Harmony Sentinel** solution gives full flexibility in defining job-based controls such as defined workflows on a job-by-job or by currency denomination.

Integration into the customers site-wide access control system ensured that only verified users with registered fingerprints and a valid smartcard had access to the **Harmony Sentinel** system and to perform the tasks and functions available to the user.

The modular and scalable approach of the system design allowed for investment protection due to the ability to enhance and expand the system without affecting already installed machinery and was retro fitted onto already purchased and commissioned equipment.

System workflow overview



- **Paper machine**

Produces 2-up reels. Normal production speeds of 60 m/min for Euro paper production

- **Slitter**

Used for slitting the input reel. Produces 2 daughter webs on the output. Max Production speed of 500 m/min

- **Foiler**

Web in, Web out based strip foil application machine. Runs at a production speed of up to 120 m/min

- **Crosscutter (Sheeter)**

Web input to cut sheet machine with a production speed of 110 m/min. Rejects waste assigned sheets at a reject gate. Produces output reams

- **Ream Checking**

Allows for reams that require verification to be checked and corrected on the output of the crosscutter

- **Pallet**

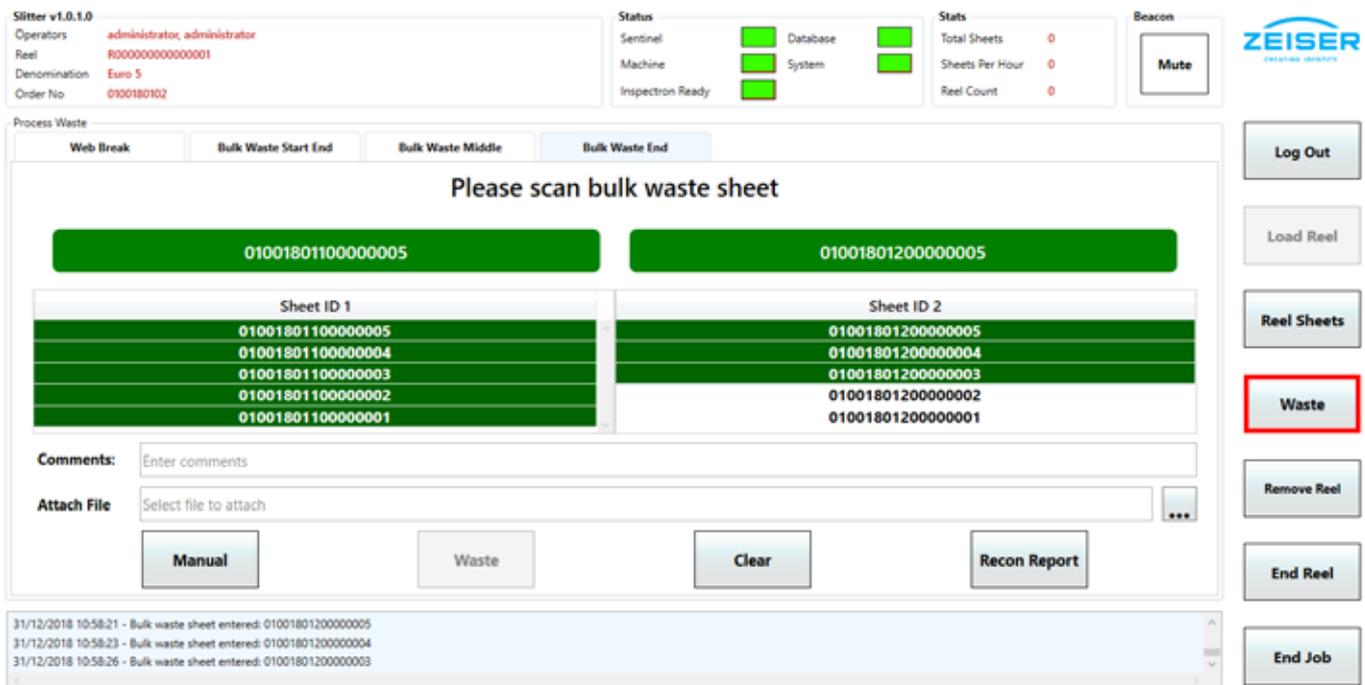
Automated robot that assembles reams of paper onto a pallet. Produces output manifests and reports for every pallet

- **Vaults**

Secure warehouses for storing raw materials, finished webs, reams and pallets

Production data is exchanged with the customers ERP system at the end of the process on each machine and is also performed for returning the list of available jobs with required job information details that can be started or resumed on the paper machine to begin the production process. This ensures that there is full transparency with regards to the status and progress of all aspects of production within the customers ERP system. The Paper machine uses a dual printer arrangement for redundancy to ensure that good quality printing is maintained while the machine is running. This allows the print heads to be swapped over the instant that the print quality starts to degrade, or a problem occurs with the head currently printing. The system then alerts the operators that a print head requires attention so that the head can be cleaned, or the ink cartridges changed ready for the next print head transition.

While using the system, the operators are guided through all process activities by clear instructions on screen informing them of the required steps to be taken during key activities such as the end of web process, defining waste material and for assigning products being collected for QA purposes for example and assigning security labels to material for tamper evidence purposes.



The screenshot displays the operator interface for the Slitter v1.0.1.0. At the top left, it shows operator information: Operators (administrator, administrator), Reel (R0000000000000001), Denomination (Euro 5), and Order No (0100180102). The Status section includes Sentinel (green), Machine (green), and Inspector Ready (green). The Stats section shows Total Sheets (0), Sheets Per Hour (0), and Reel Count (0). A Beacon section has a Mute button. The main interface is titled 'Please scan bulk waste sheet' and features two columns of sheet IDs. The left column is labeled 'Sheet ID 1' and the right 'Sheet ID 2'. Below these are input fields for 'Comments' and 'Attach File'. At the bottom, there are buttons for 'Manual', 'Waste', 'Clear', and 'Recon Report'. On the right side, a vertical toolbar contains buttons for 'Log Out', 'Load Reel', 'Reel Sheets', 'Waste' (highlighted with a red border), 'Remove Reel', 'End Reel', and 'End Job'. A log window at the bottom left shows recent waste sheet entries with timestamps and IDs.

Electronic and paper-based reports are automatically generated for each produced paper reel, waste bale, customer sample report, finished pallet etc. These automatic reports are also complemented by reports that can be ran on an ad-hoc basis such as shift reports, production job status reports etc.

Waste reconciliation at each stage of production ensures that all sheets are recorded and 100% verification is achieved. Waste functions allow for the **Harmony Sentinel** system to handle all types of waste, from waste on the reel inner core and web breaks in the machine.

On the Sheeter, automatic reading of waste sheets as they are sent to the waste gate output also helps ensure that all waste is accounted for and are assigned to a specific waste bin/pallet for tracking purposes. Sheets removed from the machine can also be scanned and assigned to waste bins within the database.

Reams of paper from the output of the sheeter can be sent to the ream checking area for reams that may not have the correct quantity, or when the machine has stopped and the doors opened. This allows these reams be counted, and corrected if necessary, using 'Stock' sheets to makeup the required ream amount. Each ream has a unique ream ID Label applied which is then scanned as the ream is placed automatically onto the output pallet. The **Harmony Sentinel** system generates a pallet ID and label that is applied to the pallet and automatically generates the Pallet printed paperwork and electronic manifest.

All waste material is sent for destruction, where a separate workstation will be used to scan the waste pallet, waste bin or waste bale containers so that they can be verified as being destroyed within the **Harmony Sentinel** system. The destruction process requires 6 eyes verification to add an extra layer of security to the process, where one of the users confirming the destruction is required to be from a dedicated security/supervisor user group.

One of the feature enhancements made to the system after its original concept and installation was the ability to track key raw material components such as threads, drums, varnish and ink pigments into production and returning of used materials back to the secure vault. This feature was implemented quickly and without impacting the use of the system in day-to-day operation as it was installed, tested and commissioned.

The **Harmony Sentinel** system allows for the QA department to take receipt of material from any machine, and can also designate the barcoded sheets for being kept as samples or as a control sample that will be sent to the end customer for them to carry out their own QA checks on the paper.

One of the key benefits for the customer has been the reporting and auditing capabilities of the **Harmony Sentinel** system that complimented the practices and usage of their already functional ERP system.

The **Harmony Sentinel** system also interacts with various hardware devices such as printers for printing out pallet and shipment labels.

The **Harmony Sentinel** solution is a fully flexible system that will allow you to manage your production processes from Goods-in or creation up to final shipment. The system provides a complete overview, report, manifest and ERP system reporting for a wide range of products such as paper and banknote production, passports, lottery tickets, tax stamps and other secure products.

Overview of ZEISER's high-resolution printer family for different printing ranges and substrate needs

- **FLUENTE iZ2** printing systems (UV inks): very fast printing speed with high resolution; extremely robust with easy to handle ink supply
- **FLUENTE Delta** printing systems (UV or water-based inks): wide printing range with high resolution and high speed
- **FLUENTE Omega** printing systems (UV inks): high printing quality with spot color; extremely versatile, robust and cost-efficient

ZEISER offers customized system configurations to meet your application requirements

- Production management software (i.e. T&T): **HARMONY**
- Inkjet printers: **FLUENTE**
- Curing devices: **SERENO**
- Transport systems: **VIVO**
- Verification systems: **VERO**

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