A Case Study in Concurrent Engineering 2.0: 
Integrating Engineering and Production with DELMIA and SOLUMINA

Scope

Before reading this case study, please read the paper “Concurrent Engineering 2.0: Transitioning from Product to Process Centric Change Management” which describes the benefits of a systematic methodology integrating many of today’s best practices and streamlining business processes, information flow and change management between Engineering and Production departments.

This paper is a case study describing how two leading software vendors, Dassault Systèmes and iBASEt, offer an integrated solution that implements the methodology described in Concurrent Engineering 2.0 for complex discrete manufacturing industries. The integrated software integrates solutions from several software solution arenas including Product Lifecycle Management (PLM), Digital Process Engineering, Operations Process Management (OPM), Manufacturing Execution Systems (MES), and Quality Assurance (QA).

This case study is targeted at Product Design Engineers, Manufacturing Engineers, Industrial Engineers, Quality Engineers, and Operations Managers and explains how integrated DELMIA and SOLUMINA software solutions are streamlining complex engineering change procedures in industries like aerospace, defense, shipbuilding, nuclear energy, industrial electronics, and complex medical devices.

Introduction

Industry leading companies have been integrating product and process change practices thanks to the integration between Dassault Systèmes’ Computer-Aided Design (CAD) and Product Lifecycle Management (PLM) products: CATIA, ENOVIA and DELMIA. Companies with a Design-for-Manufacturing philosophy have achieved great results in engineering performance on their latest programs by implementing concurrent product and process engineering.

In parallel, industry leaders have also been achieving great benefits in operations from the integration of process planning, quality management, and paperless production execution with iBASEt’s SOLUMINA software suite. This integration has streamlined the information flow between Manufacturing Engineering, Quality and Production departments.

The next wave of concurrent engineering improvement is achieved by integrating engineering and shop floor systems into one streamlined collaborative business process that includes Product Design, Manufacturing Engineering, Industrial Engineering, Process Planning, Quality Engineering, Operations and Supplier Management. The DELMIA and SOLUMINA integrated solution creates a systematic information flow between Engineering and Production with process-centric change management.
The integrated DELMIA and SOLUMINA software solution yields the following benefits:

- Shortened cycle time for getting new or improved product to market
- Shortened response time for Quality issues that require product or process Engineering design changes
- Reduced number of product and process changes
- Reduction of the learning curve for production of new or improved products
- Systematic reconciliation of as-designed, as-planned, and as-built product configuration

**Integrated Concurrent Engineering Tools**

DELMIA and SOLUMINA put the management of the process Work Plans at the center stage and all other enterprise systems for manufacturing are then synchronized to Work Plan revisions. The MBOM and Process Routing become byproducts of developing process Work Plans. This paradigm reduces the number of systems that must be reconciled because it is necessary only to reconcile the product design revisions to the Work Plan revisions.

The maturity and consolidation of solutions in the DELMIA and SOLUMINA software suites has brought about centralized databases and integrated work flows that enable departments to work in a collaborative environment with shared communications and change control mechanisms. The integration of the two products creates the final bridge between Engineering and Production disciplines.

![Diagram](Figure 1. Integrated and streamlined software tools for Process Engineering and Production.)
The DELMIA and SOLUMINA integrated software toolset includes the following:

- 3D Process Visualization and Producibility Analysis Simulation for assembly, human factors, robotics, and machine tools
- Work Process and Operation Flow Definition and Optimization
  - Work Plan Routings and Precedence
  - Production Flow can be optimized with discrete event simulation, analysis, and optimization including impacts to plant layout
- Resource Utilization Planning (Tooling, Personnel)
- Work Instruction Authoring with Illustrations based on 3D Models
- Dispatch of Work to the Shop Floor with integration to Holds for Engineering Changes.
- Online Shop Floor Instructions for the Mechanic with Change Notification
- Online Data Collection, Verifications, Approval and Buyoff Signatures
- Work Order Instruction change process for deviations tied to Discrepancies or Part Shortages

**Integrated Information Flow between Engineering and Production**

The integration of DELMIA and SOLUMINA creates a bridge between Engineering and Manufacturing tools with integrated change management and workflow from Engineering to the Shop Floor.

The DELMIA and SOLUMINA integrated solution allows the Manufacturing Engineer to change the formal process on the shop floor with online live collaboration among Engineers in multiple disciplines. Manufacturing Engineers (MEs) can halt the production process for work-in-process if necessary for urgent changes. MEs can assess the impact of a product or process change using 3D visualization and simulation tools in DELMIA. Changes that used to require days can now be approved in a few hours and incorporated into production units in a few minutes.

Following is a list of the main steps in the business process flow between DELMIA and SOLUMINA which picks up after a release of a product design change from Engineering.

In CATIA and ENOVIA,

1. Author Product **3D Models**.
   - Product Design Engineers under change authority, author the product structure parts tree, which is called the Engineering Bills of Material (EBOM). The 3D model geometry is authored for each part and associated hierarchically in the product structure.
In DELMIA,

   Manufacturing Engineers receive notice of change actions from Product Engineers. All changes made on process models are under change authority and are internally cross referenced to the product model objects and revisions. Resources definition includes subassemblies and tooling. From this point on, the Work Plan revision becomes the change control agent for downstream changes.

   The process Work Plan precedence is used to generate the Manufacturing Bill of Material and to autogenerate any phantom part numbers required to accommodate scheduling and management for intermediate assembly states across locations or suppliers. Manufacturing Planners are still autonomously creating and managing manufacturing subassemblies through the Work Plans. The Work Plan precedence diagram is also used in manufacturing optimization and simulation analysis.

3. Analyze and **Validate** Process in 3D.
   It is very easy to overlook consequences of product design changes on process and tooling. With the DELMIA toolset, the manufacturing process and tooling is easily validated in a virtual 3D environment and avoid costly mistakes in actual production.

4. **Optimize** and Balance Process Flow through the Plant.
   Optimization exercises are usually done at the beginning of new programs; however, it is just as important to revisit simulation models after significant changes are made to the manufacturing process or facility.
5. **Author 3D Visualization** for Work Instructions.
   They say that a picture is worth a thousand words, a 3D process visualization is worth much more. 3D process models leverage the investment in 3D product models, and 3D visualizations for work instructions leverage the investment in 3D process models. 3D visualizations are internally cross-referenced to objects in the product model, and also associated with process operations that are passed to the execution system.

6. **Reconcile** derived MBOM and Work Plans to EBOM.
   DELMIA can derive the MBOM from the Work Plan Precedence. DELMIA leverages the 3D model-based GUI to facilitate the reconciliation along with the visual manipulation of the product model. The reconciliation of the derived MBOM to EBOM also guarantees that the EBOM was correctly mapped to Work Plan operations.

   The Manufacturing Engineer also verifies that all critical engineering requirements and specifications have been mapped to the appropriate work plan operations.

In SOLUMINA,

7. **Author Additional Inspection Requirements**
   The Process Planner or QA Planner completes the development of the data collection requirements for the mechanic on the shop floor. The Process Planner can package all the information including bookmarked passages from standard procedures and can further add pictures and video to work instructions.
The QA Planner adds process-centric control limits, sampling rules, and flags for First Article Inspection requirements. Sampling plans may also include additional process data collection and material tracking requirements.

8. **Execute Production** with online Visuals, Data Collection and Status
Work Orders executed with online work instructions ensure that the mechanic is always accessing specifications for the correct configuration and engineering change level. The use of model- and multimedia-based work instructions greatly reduces the learning curve and the need to translate a lot of instruction text for global operations.

The paperless online execution system provides real-time visibility of shop floor data to engineers and integration with the Enterprise Resource Planning (ERP) system ensures that scheduling, inventory, and financial process are synchronized to the shop floor.

9. **Document Production Discrepancies and Corrective Action**
When inspectors or mechanics discover a discrepancy, they quickly document it and route it to Engineering for disposition. The engineer can quickly display the issue including production history to help diagnose the problem. For critical issues, the engineer can place additional work on hold and supersede work instructions with corrected specifications and instructions in minutes.
The integration of planning and execution functions eliminates the need to keep many log books that reconcile documents routed from the shop floor. All reconciliation tasks become automated background tasks.

The integration of execution and Quality Control helps to identify process operations that require more detailed work instruction in order to prevent repeated errors.

10. Manage **In-Process Production Changes**
Work Order instruction changes can be due to engineering changes, or to repairs or part shortages on specific production units. Tightly integrated change control procedures and configuration management eliminate the need for extensive reconciliation procedures at the end of the manufacturing process.

Shop operators are alerted to any work on hold and can review the change once the Work Order is again released to production. This integration of engineering and shop floor processes is especially important during the production of the first batch of a new product or major product revision, when unforeseen problems are most likely to arise.

The integrated work flow between DELMIA and SOLUMINA facilitates process-centric change management. The DELMIA software leverages the 3D model-based user interface and the SOLUMINA software leverages a database optimized for high volume transactions and 24x7 availability.

**Summary**

The implementation of Concurrent Engineering 2.0 practices is enabled by the integrated DELMIA Process Engineering and SOLUMINA Operations Process Management software suites.

The DELMIA and SOLUMINA integrated solution streamlines business processes between Engineering, the global supply chain and the shop floor, and provides the following benefits:

- Leveraging of investment in 3D models throughout the product lifecycle
- Shortening cycle times for getting new or improved product to market
- Quicker turnaround cycle for quality issues that require product or process design changes
- Improved change implementation between Engineering and Production
- Reduction of the number of product and process changes
- Reduction of learning curves for production of new or improved products
- Automated reconciliation of as-designed, as-planned, and as-built product
References

For more information on DELMIA Process Engineering solutions visit [www.delmia.com](http://www.delmia.com).

For more information on SOLUMINA Operations Process Management solutions visit [www.solumina.com](http://www.solumina.com).

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