



# Practical Application of DELMIA PLM to Development and Production Engineering

*Collaborative research with DELMIA user, Sanden Corporation, a leading manufacturer of refrigeration and heat exchange products, including vending machines sought to attempt to "frontload" the development process.*

Essentially, the researchers wanted to find a way to incorporate steps to resolve product development issues early in the design stage to improve product quality while responding faster and more flexibly to customer needs.

Ideal Business Process Model for Sanden

As a vending machine manufacturer, Sanden needs to meet the demands of beverage companies, who like to renew machine design and specifications each year. Since each new machine and component is designed individually to the brand specifications given by its customers, there are few parts that can be shared among models that are ever-diversifying. This leads to redundancies in design and manufacturing processes, causing delays in development and adding to costs. To solve this problem, Sanden has drawn up a new business scheme (Fig. 1).

Professor Tamaki of Aoyama Gakuin University School of Business Administration, Aoyama, Japan, developed a methodology that calls for a thorough analysis of the structure and components of each and every existing model, based on a new machine architecture. He and his team determined that it should combine common functional modules and other components and will lead to the creation of an integrated design BOM (bill of materials) to cover all

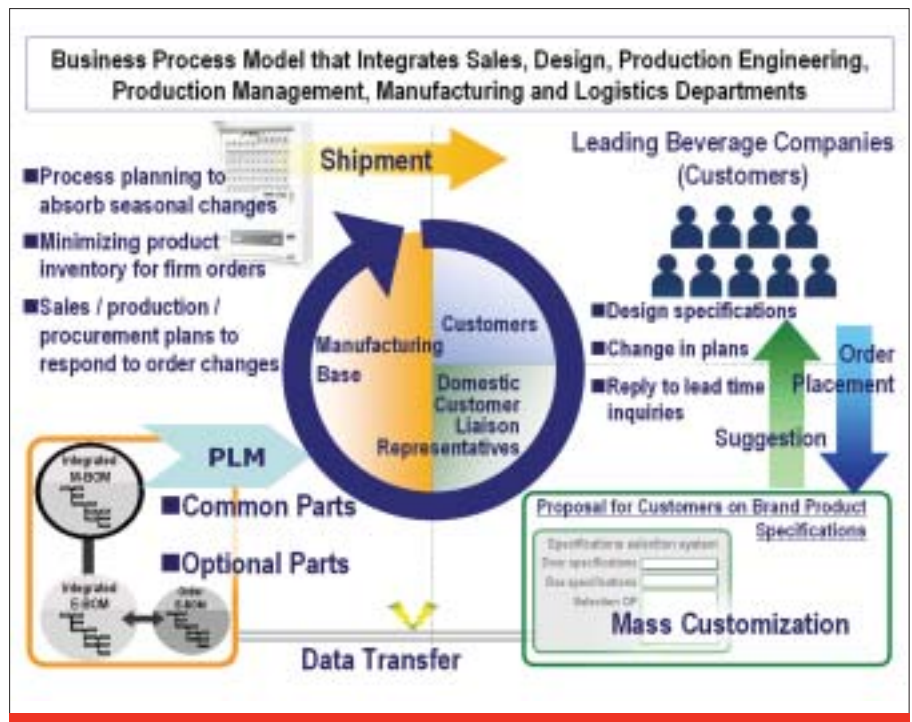


Fig. 1: Sanden's ideal business scheme

models. From this, a manufacturing BOM will be generated, and then individual processes will be designed and process BOMs made. Finally, the process BOMs will be used to determine individual work protocols, and work-station BOMs (WS-BOMs) will be developed.

The next step involves designing manufacturing procedures based on structural information about the products, including product design data and functional module data. The order and priorities of assembly works will be determined at this stage. Then the manufacturing procedures must be virtually validated by digital mockups and process simulations featuring digital manikins.

Case Study on Vending Machine Door Assemblies

### Creation of design BOM

To begin with, vending machines of different types and sizes were selected from several product brands. The structure of the door assembly was analyzed and the

components were classified into functional modules (delivery bin, coin acceptor, merchandise display, etc.). The parts required for each module were further divided into the following categories:  
(1) parts common to all;  
(2) parts common to specific customers;  
(3) parts common to vending machines of a specific size.

These functional modules were added to DELMIA Process Engineer's PPR hub. For each module, common part categories (1) to (3) were created, and the constituent parts of each module were defined. By defining all modules down to the smallest part, a unified design BOM for door assemblies was created to cover the entire product line.

### Creation of manufacturing BOM

Prof. Tamaki explains: "First, DELMIA DPM Assembly was used to determine the optimum order of assembly for each model. This solution checks for collision and interference between parts by means of digital mockup simulations to define the

# FABRICATION & ASSEMBLY



optimum assembly order. Next, the parts module data and the order for assembling the parts were electronically paired. The time it would normally take to complete each assembly task was defined and shown in a Gantt chart, based on which variances were corrected and the process plan was optimized. Thus a unified manufacturing BOM that covered all parts and models was completed."

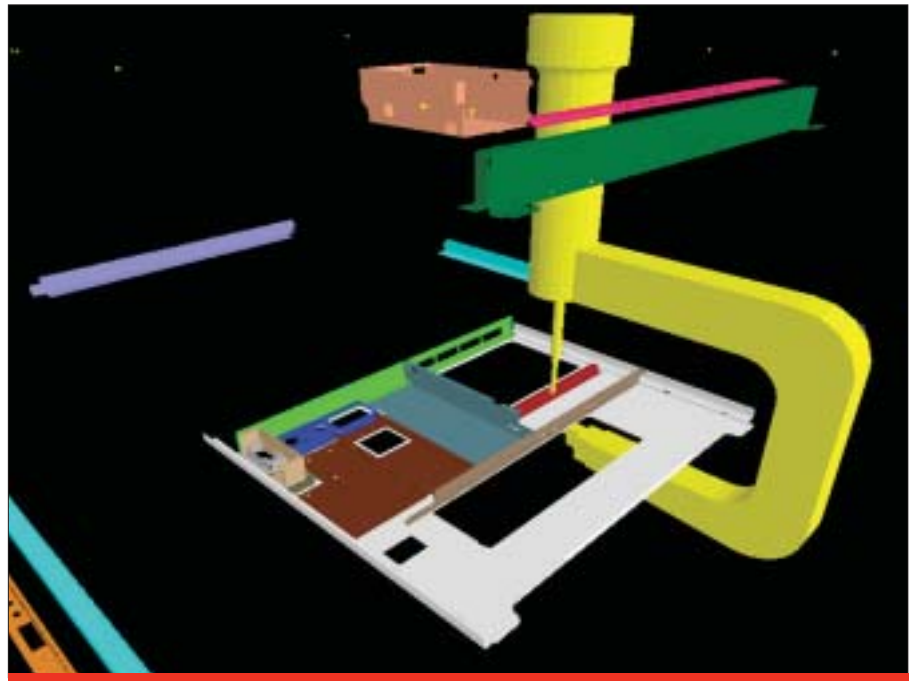
### Creation of process BOM

The production of vending machines is subject to seasonal changes in demand, so mixed production lines have to be used, and process plans and production cycles change several times a year. To balance the workload of different production lines, the allocation of parts, workers, and work station resources must be adjusted each time the process plan changes.

Production line data fed into DELMIA Process Engineer and DELMIA QUEST included the resource plan, layout, equipment, target cycle time, and actual time it currently takes for each work station to complete a task. Based on these inputs, process plans were made before actual production began under the new scheme.

### Creation of WS-BOM

Prof. Tamaki comments: "A WS-BOM must be produced for each work station on a production line. Based on the information contained in the process BOM, the



Verification of a spot welding path on vending machines by using DPM Assembly

necessary data on required parts, work description, and the arrangement of resources needed at each workstation were defined to create WS-BOMs. DELMIA Human was also used to assess the work procedures, workers' safety, workload, workspace constraints, and time and manpower needed to perform specific tasks. Data obtained with this simulation solution can be shared with DELMIA QUEST for detailed evaluation of production lines and workstations. These work simulations can be used not only for product development but also for generating work instructions." (Fig. 2)

### Expected Results

Process engineering based on unified function-specific BOMs was found to have the advantage of reducing the development lead time by frontloading many of the processes, which also allows early detection and resolution of problems and leads to improvement of quality in individual processes.

To promote frontloading even further, it will be necessary to construct a virtual production line that accurately mirrors the actual facility. For this, the practical know-how of line workers must be tapped, so that continuous improvements are made through a combination of co-operation, simulation, and process engineering.

"While the case study focused only on door assemblies for vending machines, our ultimate goal is to build an integrated platform that covers the entire structure of every vending machine we have," Prof. Tamaki adds. "The other goal is to train capable engineers and managers to take the lead in future manufacturing. Our joint research is focused on achieving those goals."

- A Joint Research Project with Sanden Corporation's Vending Machine Plant -



Fig. 2: Work verification by assembling digital mockups and conducting process simulations using digital manikins

Information about Aoyama Gakuin University at: [www.aoyama.ac.jp](http://www.aoyama.ac.jp)