Optimizing
Continuous Replenishment
At
Danone de Mexico

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ABSTRACT

Danone de Mexico (DDM herein), a subsidiary of the Groupe Danone, is one of the key players in the Mexican dairy industry. It manufactures and distributes over 100 products and 250,000 annual tons through a network that, at the time of the project, was comprised of a main manufacturing plant, two regional distribution centers and 33 local warehouses.

In 2003 DDM established a central Supply Chain group with the mandate to improve the overall performance of the plant to depot replenishment process. The operation was plagued by problems typical of complex operations lacking synchronization, coordination and planning tools: customer service issues, stockouts, high transportation costs and spoilage (critical in the dairy industry).

In August of 2003 the Supply Chain group commissioned the services of Technologix Decision Sciences Inc. to design, develop and implement a customized continuous replenishment system to help the organization address the issues above.

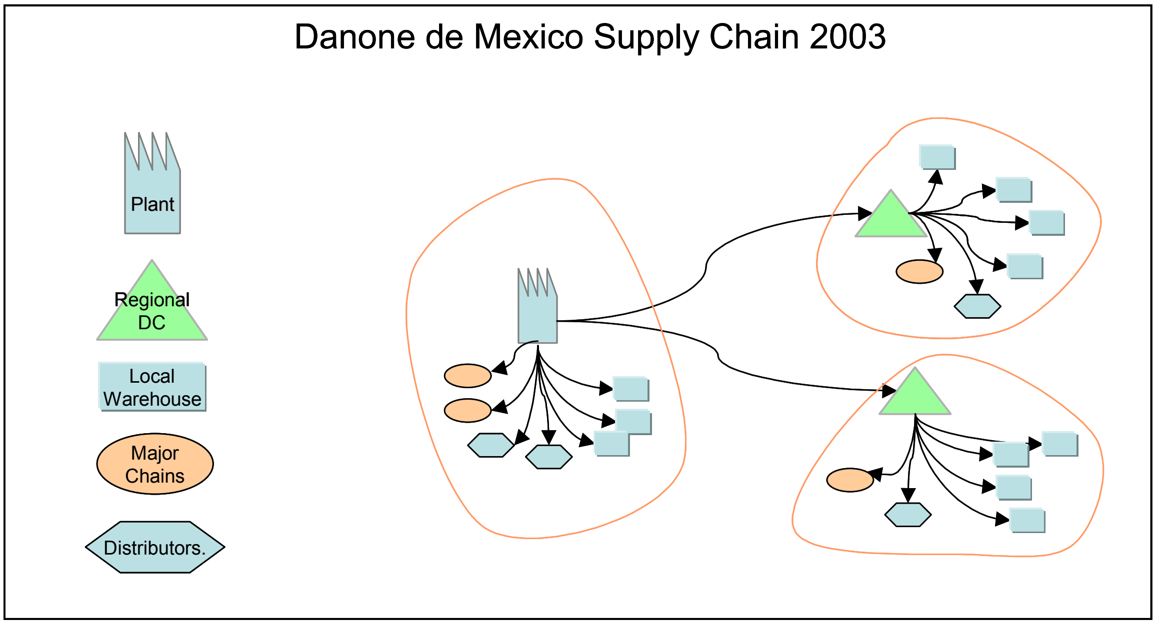
The system has been operational since the fall of 2004, and the results to date have been very promising, including a dramatic reduction in stockouts and product losses due to spoilage while, at the same time, reducing overall inventory levels, adjusting to changes in the network configuration and facing a 22% growth in tons sold.

Scoping, modelling, developing and implementing the DDM continuous replenishment solution in less than a year was a major undertaking, and we want to share with our readers our journey, what facilitated it and its major challenges.

BACKGROUND

At the turn of the century, DDM's supply chain was comprised of a main manufacturing facility, two regional distribution centers, 33 local warehouses and 60,000 monthly product movements to customers.

The plant warehouse and the regional distribution centers had 3 main types of customers: Major supermarket chains, distributors and the local warehouses assigned to them. Major supermarket chains and distributors were shipped to order. Warehouse replenishments were based on forecasts. Individual local warehouses were replenished in full truckloads on a fixed weekly schedule.



DDM's warehouses reported into Sales. Each warehouse would estimate its weekly and daily requirements and convey them to the Replenishment group at the plant.

At the same time, the Logistics Planning function would generate its own forecasts of warehouse demand, consolidate the figures nationally and drive daily and weekly production schedules based on them.

Needless to say, the two streams of numbers rarely matched. This, combined with the promotion-driven sales pattern typical of the consumer goods industry, resulted in:

- Constant supply-demand imbalances
- Warehouses, chains and distributors fighting for scarce inventory
- A very reactive operating mode, a particularly risky proposition in the case of perishables

To ensure sufficient supply, warehouses would overestimate requirements. Because of the perishable nature of the products, any resulting excess inventory would be heavily discounted to avoid spoilage due to expiry date restrictions.

With lots of effort, number crunching and an ample supply of Tylenol and Valium the process sort of worked. Not very efficiently or effectively, but it worked.

However, in the early 2000’s things began to unravel. Competitive pressures and the dynamics of the marketplace were forcing an expansion of the product line, an increase in promotional activity and a renewed emphasis on lower logistical costs.

Faced with these changes, the process that “sort of worked” for many years began to struggle, displaying problems typical of complex operations lacking synchronization and planning tools: customer service issues, stockouts, higher transportation costs, unprofitable production runs, excessive product spoilage and a lot of friction between the functional areas involved

To address these issues, in 2003 DDM restructured its logistics function, establishing a Supply Chain group with the mandate to improve the efficiency and effectiveness of the plant to market product delivery process.

One of the first and main thrusts has been the implementation of a new and fully integrated decision support system to help the organization accomplish these objectives. The system was to be implemented at the plant warehouse facility.

For a complex project and system implementation of this nature to succeed, three aspects have to be addressed: Doing the right things (defining the proper scope), doing the things right (sound algorithms, functionality and system interface), and being able to ‘sell’ it internally (collaborative approach, project team and implementation plan).

In the sections below the writers share this challenging journey, starting with its conceptual design in 2003 to its full implementation in 2004 and resulting benefits.

THE PLAN, ON PAPER

In our preliminary discussions regarding the scope of the system, five major objectives were identified:

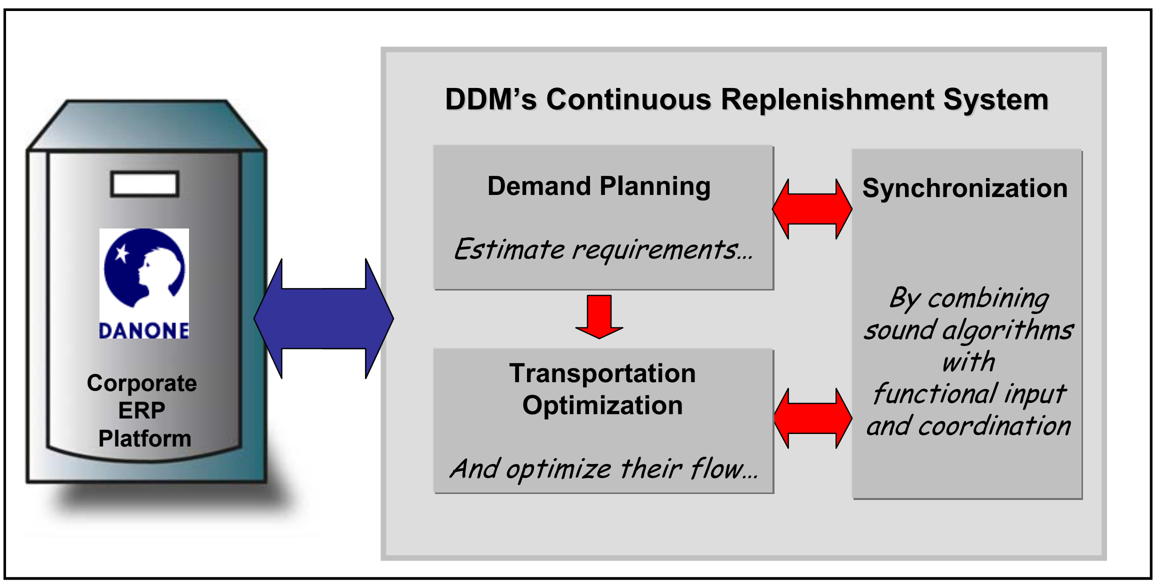
- Improve the accuracy of daily warehouse requirement estimates
- Establish a more objective way of allocating stock in situations of shortages
- Optimize the warehouse replenishment process
- Improve the synchronization/coordination across the entire operation
- Ensure the 'universality' of the system, so it can be deployed at other locations within the network, if so required

The development and implementation of the system was structured in three sequential modules:

Demand Planning
Estimate daily requirements by warehouse and product

Transportation optimization
Translate these requirements into a cost-effective replenishment schedule

Synchronization
Maximize effectiveness by ensuring the system communicates and is synchronized with key functional areas



We knew upfront that the supply chain was going to experience dramatic changes in the not too distant future, including its reconfiguration and a significant expansion in volumes and products.

The design of the system exploited the data-driven design concept to its maximum, ensuring the system would adjust to the changes above. Using this approach we have been able to incorporate a new central distribution source, install the system there, re-allocate local warehouses to new sources and run a two-tier scheduling process with minor adjustments to the logic.

The system is designed to run daily and program up to 2 weeks detailed rolling schedules, including the detailed dispatch of loads to regional distribution centers and local warehouses.

DEMAND PLANNING

From the plant warehouse perspective, there are 3 types of customers demanding product on a daily basis: major supermarket chains, distributors and all the warehouses (regional and/or local).

Supermarket chains and distributors daily demand is deterministic, given by confirmed orders placed before 4pm on the day prior to shipments. Warehouse requirements, on the contrary, have always been quite volatile and therefore problematic to estimate.

At the time the Supply Chain organization was established in 2003, warehouse daily requirements were ‘guesstimated’ by the warehouses themselves, which at the time happened to report into Sales.

Supply Chain management decided this had to change. Detailed daily warehouse product requirements would no longer be estimated by the warehouses themselves. It would be done by the system based on a forecast and dynamically adjusted inventory targets:

If we define:

F (t)	Sales forecast in period t
Inv (t)	Inventory target at the start of period t (or open inventory for t=1)
Inv (t+1)	Inventory target at the start of period (t+1)
Req (t)	Net product requirement in period t

Then:

Req (t) = Inv (t+1) + F (t) – Inv (t)

Forecasting

A time series forecasting model was developed to forecast weekly sales by product family and warehouse. Smoothed historical splits are then applied, first to split the weekly family forecast by product, then to allocate it by day of the week.

Danone’s network has a two-tier configuration (plant to regional distribution center to local warehouse). The Demand Planning module uses a ‘bottom up’ approach, forecasting at the local warehouse level, consolidating daily requirements at the ‘parent’ level and scheduling deliveries accordingly. This approach allows DDM to quickly adjust the system to any changes in the configuration of the network.

Dynamic Inventory Targets

Because of the seasonality pattern of daily sales within the week, we felt it necessary to dynamically adjust inventory targets by product and warehouse on a daily basis.

The Demand Planning module incorporates an inventory control model developed specifically for this purpose. It will automatically adjust safety stocks and daily targets based on lead times, estimated sales, forecast errors and the importance of the product in terms of demand (ABC classification).

Allocating Stock in Shortage Situations

Once the detailed daily requirements are calculated, the system consolidates the information at the plant level and totals the daily demand by adding to these requirements the corresponding supermarket chain and distributor orders. The module incorporates a model that, based on priorities, will allocate available inventory in shortage situations.

TRANSPORTATION OPTIMIZATION

Once we have determined the daily requirements and volumes to be assigned by warehouse location and product, we need to translate them into a cost-effective delivery schedule. That is the task of the transportation optimization module.

This module is composed of two integrated heuristic models: Load Builder and Load Scheduler.

Both models base their decisions on the capacity dispatch table.

In this table we include every feasible route, be it single or multi-stop. For each route and day of the week, the table will identify (with a zero or a one) what hours of the day a truck could leave the source point and arrive at the destination, based on loading capacity, time windows and maximum waiting time at the destination, transportation lead time and unloading time.

Among other things, this unique table provides us with two important pieces of information: How easy it is to schedule the route on any given day (if the total 'ones' are close to 24) and whether it is difficult (just a few possible time slots) or even possible to be shipped at all on that day (zero entries).

Load Builder

The deliverable of this model is a detailed list of loads to be shipped in each of the coming 14 days, using the following logic:

- Based on the requirements, calculate the number of full trucks and partial trucks by destination. Full truckloads are 'set aside' for scheduling.
- We are left with partial loads. If the load does not exceed the minimum pallet drop size, it is moved to the next day.
- The next step is to try to combine partial loads in multi-stop deliveries. The model follows an iterative approach to check what loads can be combined and how to 'top

up’ the loads to fill the truck. These calculations are driven by a number of rules and parameters set by the user community.

- All loads that cannot be scheduled (capacity dispatch table) or partial loads that cannot be combined are moved to the next day.
- Depots that have not any full loads scheduled are given priority among the partial loads scheduled (service level consideration)

Load Scheduler

The Load Builder provides us with a list of loads to be scheduled in each of the coming 14 days, by day, shift and hour. It is the job of the Load Scheduler to build a feasible and efficient daily delivery schedule for them, based on the following logic:

- Rank the loads as a function of the importance of the destination and the total loads already designated for shipping to it
- Starting from the top of the list, find a loading slot with a match in the capacity dispatch table. Assign the load to that slot. In order to balance shifts, start the search in the shift with most slots available
- At the end of the first pass there may be still loads left to be allocated for which there is no available loading capacity in their permitted time slots, but there is still some available loading capacity available in other time slots. If so, we check each time slot that could have been used to ship this truckload but had already been allocated to see if the currently allocated truck could be shifted to one of the still available loading capacity time slots.
- Once this procedure is complete for the day, we store the information of the loading pattern and continue to the following day until the end of the specified loading date range.
- Once the schedule is reviewed and if necessary adjusted by the users, it is uploaded to the corporate ERP environment for further processing and, eventually, load picking and dispatching.

SYNCHRONIZATION

Five key elements have helped make the system developed at DDM a success:

- Improved forecast accuracy at the warehouse/product level
- The matching of production and replenishment schedules
- Sound routing and delivery schedule algorithms
- A user-friendly and reliable interface
- Integration of the application to the corporate ERP environment

We described the algorithms in the previous section, and will cover the user interface in the following one. In this section we focus on the other three elements, which were achieved by synchronizing and coordinating the activities surrounding the system with other areas in the organization.

Forecasting Accuracy

The forecasting models in the Demand Planning module improved the accuracy of weekly and daily forecasts. However, they are time series models based on historical data, and do not factor future promotional activity so critical to actual sales levels.

The Marketing/Sales department at DDM generates monthly forecasts by warehouse and product, which reflect promotional plans for that particular location. This data is imported to the system, and compared to the aggregate monthly forecast it generates for the corresponding warehouse and product. Users can extrapolate detailed forecasts by applying the ratio of the two monthly figures. This process of synchronization was able to further improve the accuracy of the detailed forecasts generated by the system.

Matching Production to Replenishment Schedules

Prior to the implementation of the system, there was no attempt to match production and replenishment schedules. This resulted in frequent supply-demand imbalances, shortages, spoilage and lots of stress.

DDM's continuous replenishment system incorporates the logic and reports required to address this issue. The system does not schedule the plant. It aggregates daily requirements at the plant level and compares totals to the daily production schedules imported through the interface.

A set of management reports helps synchronize the two sets of numbers and flags variances in total weekly production versus required quantities.

Integration With The Corporate ERP Environment

As an operational, quasi-real time planning and scheduling tool, the system requires and consumes a large volume of daily input data. The resulting delivery schedule, including the composition of each load, is uploaded to the corporate environment for further processing.

A major component of both the development and implementation focused on adapting the logic and interface to the corporate data structure, ensuring a seamless, relatively error-free operation.

THE PLAN, IMPLEMENTED

The entire project, from the preliminary scope discussions to completion, took approximately 11 months. The final version was installed in the fall of 2004.

We knew we were about to navigate uncharted waters at DDM, introducing quite a dramatic change in the way its replenishment process was going to be managed and controlled. As a team we therefore designed a project plan that would allow us to adjust as we moved along and, in doing so, gain the support of the user community and minimize their resistance to change:

- Multifunctional project team
- Implementation in phases
- Flexibility
- Functionality
- Metrics
- Support

Multifunctional Project Team

The project team incorporated staff from other functional areas of the company, including IT, Traffic, Marketing and Production. Among other things, this helped define an overall scope that addressed the main concerns of all major parties affected by the new system and avoid the 'them against us' scenario.

Implementation in Phases

Implementing in phases offers two important benefits:

- It allows the team to carefully validate and calibrate the logic in chunks, and not all at once, making the entire process more efficient
- It generates interest and support through the generation of initial benefits

In our particular case, with the completion of the Demand Planning module 3 months into the project, better quality forecasts and inventory targets had an immediate contribution in the day-to-day operation.

Flexibility

As is the case with most decision support systems of this nature, the final DDM tool was similar, but not identical to the one originally scoped. Some aspects of the operation that a-priori seem critical end up not being so, and vice versa. Also, the models developed usually require adjustments that only become evident during the validation and calibration process.

For this reason it is essential to have the flexibility to adjust both logic and functionality (reports, data forms, etc.) during the design and implementation process.

Functionality

The system incorporates numerous reports, graphs and forms that allow users to analyze and edit its recommendations, such as forecasts, load composition and load scheduling.

Metrics

The system monitors and reports compliance to plan at various levels (total loads, loads by destination, volume by product), contributing to the overall improvement in performance reported in the following section.

Support

When you are working on tomorrow’s schedules late in the afternoon, using concepts you understand but are not yet comfortable with, and you run into difficulties, you want help now. Not in two hours or tomorrow morning, but right now. We made sure this support was available, and it played a critical role in the early days post-implementation, helping gain the acceptance of the user community.

BENEFITS

The improvement in the performance of the operation, since the implementation of the new system, has been quite impressive. We summarize below the key performance indicators, comparing the first five months of 2005 to the same period last year.

All indicators show improvement. With the help of this system the organization has been able to dramatically reduce the out of stock situations and product loss due to spoilage, while at the same time reducing aggregate inventory and marginally improving customer service levels:

Indicator	Units	Jan/May 2004	Jan/May 2005	% Change	Comments
Total Tons Sold	Tons (000)	85,464	104,223	21.95	
Service Level	%	95.30	95.95	0.68	Weighted Average
On Hand Inventory	Days/Supply	10.36	9.76	-5.79	Weighted Average
Out Of Stocks	Occurrences	616	356	-42.21	
Transfer Freight	$Mex / Ton	366.8	365.0	-0.48	04 adjusted for inflation
Total Product Loss	$Mex (MM)	16.7	11.9	-28.74	Spoilage
Product Loss/Ton	$Mex / Ton	0.19	0.11	-42.11	Spoilage

The figures above suggest that the system is helping forecast requirements more accurately, maintaining the right amount of inventory, assigning it where it is required and moving the products in a more cost-effective way. The product loss per ton, in $ Mex, factors the 22% growth in tons sold.

These results are even more impressive, given that they were obtained in the midst of some major changes and restructuring that have taken place at DDM over the past 8 months:

- A 22% growth in total tons sold, which has placed enormous pressure on both production and storage resources.
- The rental of temporary storage space to accommodate such growth.
- The opening of a new regional distribution center in Mexico City, with all the transitional headaches and inefficiencies that go hand in hand with such undertakings.
- The testing of the cross-docking concept in a number of local warehouses.

Finally, the data-driven design concept used in its development allowed the system to quickly adjust to these network changes and to continue to support the organization without delays or inconveniences. This is clearly a qualitative yet an important feature: having a tool that can easily adapt to change, something tougher to do for personnel used to doing things the ‘old way’.

CONCLUSIONS

Danone de Mexico had to make a change in how it operated. To stay competitive in a fast changing environment it had to improve it is logistical processes and reduce overall supply chain costs.

With pragmatic quantitative tools, strong management support and a practical implementation plan it was able to accomplish this in a relatively short period of time, while in the midst of quite significant internal and external turbulence.

The ride was not always smooth, and the process definitely not painless. However, through true team effort and the ability to adjust on the go, without losing sight of the goals, the project team weathered the storms and delivered a system that is currently generating very impressive results.