

NUTECH SOLUTIONS

CASE STUDY

UNILEVER



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COMPANY BACKGROUND

Unilever was formed in 1930 when the Dutch margarine company *Margarine Unie* merged with British soap maker *Lever Brothers*. Between the two companies, the new Unilever had operations in more than 40 countries. Since 1930, the two companies have operated as one, linked by a series of agreements and shareholders that participate in the prosperity of the whole business. Unilever's corporate headquarters are in London and in Rotterdam, and Unilever PLC and Unilever NV are the parent companies of one of the largest consumer goods businesses in the world. Well-known brand names owned by Unilever include Ben & Jerry's, Country Crock, Lever 2000, Lipton, Q-Tips, Dove, Slim-fast, Wisk, Hellmann's, and Skippy. Unilever employs more than 250,000 people, and generated revenues in excess of \$46 billion in fiscal year 2000.

UNDERSTANDING CUSTOMERS NEEDS

Scheduling systems for manufacturing are plentiful, but most are based upon assumptions developed in an era when manufacturing took place in a less changeable business environment. They assume that customer demand is relatively steady or varies slowly across a long time scale; that it is more cost-effective to turn out large quantities of products quickly than to vary production according to demand; and that all machinery and processes in the factory will work as planned. Most of the software currently available for manufacturing scheduling is simply a translation of these old assumptions into computerized form rather than a new approach to the problem, so its usefulness in today's manufacturing environment is no great improvement over the pencil-and-paper scheduling solutions of the past.

Unilever's linear production models, tied to historical sales, were inadequate to handle the subtle shifts of the marketplace and did not take into account variables like mechanical malfunction at the production stage. In addition, existing factory designs and configurations were poorly suited to the diverse demands today's consumers placed on them. The linear approach to the production process rarely optimized output, and the probability of downtime needed to be minimized to improve productivity and profitability.

SCHEDULING OPTIMIZATION

NuTech Solutions developed an advanced technique built on foraging ant-based algorithms. Ants, in their search for food, are able to establish trails to find the shortest path from their nest to a food source, known as "greedy" behavior, based on immediate local rewards. On a secondary level, they apply random exploration to discover changes in the system, centered on global reinforcement learning. These advanced techniques, based on natural processes found in nature, allow manufacturers to schedule smoothly around glitches, temporary downtime, and other internal problems.

Using the ant-based algorithm, NuTech Solutions used cooperative agents (artificial ants) to rework Unilever's scheduling. "Living" in a mathematical space, these cooperative agents explored, found, and reinforced pathways filled with complex information to find optimal solutions. The algorithms were flexible and adaptive to changes in the system. Once a solution was uncovered, the algorithm continued to work on modifications to find new and additional solutions without the need to start computations from scratch.

In adapting this model to Unilever's production issues, advanced scheduling techniques were created. These resulted in improved schedules for static problems, and when alterations were needed (due to changing customer demand or machine breakdown), reinforcement learning techniques rapidly found new and viable solutions.

RESULTS

NuTech Solutions' scheduling optimizer outperformed Unilever's state-of-the-art scheduler (enhanced by hand tuning) by 4% and reduced the time required to run a new schedule to accommodate changing parameters from one-half hour to thirty seconds. Unilever also found these techniques effective in designing new manufacturing facilities. These proprietary algorithms identified "sweet spots" where a tiny incremental investment in a factory led to a dramatic improvement in productivity and profitability. Adaptive scheduling also provides Unilever with the technology to cope with rapid changes by shifting gracefully from old sub-optimal solutions to new improved solutions based upon up-to-the-minute information, order flow, and the state of the system.