GE Plastics Optimizes the Two-Echelon Global Fulfillment Network at Its High Performance Polymers Division

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To achieve the highest customer satisfaction at the lowest costs, GE Plastics adopted a global approach to its manufacturing operations. Previously it met demand in one geographic region with production from that region only. It developed a decision-support system (DSS) to optimize the two-echelon global manufacturing supply chain for its high performance polymers division. The DSS uses a math-programming model to maximize contribution margin while taking into consideration product demands and prices, plant capacities, production costs, distribution costs, and raw material costs. The results of the model are the optimal production quantities by plant and the total contribution margin. The DSS is implemented in Excel and uses LINGO to solve the optimization model. After successfully implementing this system at the high performance polymers division, GE Plastics is rolling it out to other divisions.

Key words: manufacturing; programming; linear, applications.

Producing products that are best in their class does not insure GE's global leadership. GE must deliver customized products to its customers anywhere in the world in the right quantity, at the right time, and at reasonable cost. In effect, the supply chain has become part of the product GE offers. With increasing supply-chain complexity, this requirement puts an unprecedented burden on GE decision systems that allocate global capacities. GE Plastics (GEP), a $5 billion global materials business that supplies plastics and raw materials to such industries as automotive, appliance, computer, and medical equipment, has set up manufacturing plants all over the globe. In the past, GEP practiced a pole-centric manufacturing philosophy, making each product in the geographic area (Americas, Europe, or Pacific) where it was to be delivered. Many of GEP's customers have since shifted their manufacturing operations to the Pacific. The result was a geographic imbalance between GEP's capacity and demand in the form of overcapacity in the Americas and undercapacity in the Pacific. Realizing that the pole-centric approach was no longer effective, in 2000 GEP adopted a global approach to its manufacturing operations. While GEP's primary motivation was to achieve a better balance between capacity and demand, it gained three additional opportunities to reduce operating costs: (1) to achieve economy of scale by centralizing production, (2) to reduce raw material costs by sourcing them globally, and (3) to take advantage of tax breaks some countries offered it to set up and operate plants even if it had sufficient capacity in that region.

The High Performance Polymers Division

GEP consists of seven major divisions; the Lexan division is the largest, and the high performance polymers (HPP) division is the fastest growing. The plastics made by these divisions differ primarily in their ability to withstand heat. For example, while Lexan plastic is suitable for automobile body panels that do not experience high temperatures, HPP is extremely heat tolerant and is used in microwave cookware, fire helmets, utensils, and aircraft.

Because of its fast-growing need for additional manufacturing capacity, we chose the HPP division to be the pilot for implementing the global approach to manufacturing planning. HPP had already decided to acquire manufacturing capacity from divisions experiencing soft demand for their products. Even so, the division expected it might need a new plant to keep up with demand in three to four years. HPP had to determine (1) how to integrate the acquired capacity into the existing supply chain and (2) whether it
would need a new plant and, if so, where to locate it and what products it should be capable of producing. GE Global Research, the primary technology development organization within GE, was ideally suited to address this challenge as it had relevant optimization modeling expertise to solve this problem.

**Demand Planning**

GE Polymerland, a wholly owned subsidiary, is the commercial front of GE Plastics, and it manages customer sales for all its divisions with a network of distribution centers and warehouses in over 20 countries. GE Polymerland consolidates customer orders into production orders and releases them to the appropriate divisions. As such, it is the sole direct customer for all GEP divisions, which deliver their products to GE Polymerland warehouses throughout the world. GE Polymerland handles delivery from warehouses to customers. To aid GEP divisions in their long-term production planning, GE Polymerland provides yearly demand estimates by pole for the next four years.

HPP sells its products both as made to stock and made to order, and it sells thousands of different grades every year that differ because of blend requirements and color. For the purpose of capacity planning, we aggregated these products into 10 categories based on similarities in manufacturing requirements. We then broke down the demand for each category by lot size (Table 1), because all HPP plants are designed to produce small lots (less than 4,000 lbs), medium lots (4,000 to 8,000 lbs), or large lots (more than 8,000 lbs) only.

In addition to estimating demand, GE Polymerland estimates the selling prices of HPP products. Some of the products are commodity items for which industry publications estimate future market price. Other products are highly specialized, and GE Polymerland must consider evolving technologies and the competitive landscape in estimating their future prices.

Once HPP Manufacturing receives the forecasts of demand from GE Polymerland, it develops a manufacturing plan detailing production entitlements for each plant, that is, what products and quantities each plant should produce. If manufacturing capacity is not sufficient to meet all forecasted demand, HPP Manufacturing must rationalize production to yield the maximum profits. After manufacturing the products, HPP delivers them to the appropriate GE Polymerland warehouses.

**Two-Echelon Manufacturing Supply Chain**

Despite differences in their underlying chemical technology, all seven GEP divisions require similar manufacturing supply chains consisting of two levels of manufacturing plants (Figure 1). The first-level plants, the resin plants, convert feedstocks into resins and ship them to the second-level plants, the finishing plants. The finishing plants combine these resins with additives to produce different grades of the end product and ship them to GE Polymerland, which delivers them to the customers.

Each physical plant typically consists of multiple extruding lines, or plant lines, that operate independently. Thus, a plant line is a single manufacturing facility. Each plant line is generally capable of making multiple products. The HPP division has eight resin plant lines that make three resins and 21 finishing plant lines that combine these resins with additives to make 24 grades of HPP products (Table 2).

Distribution costs of resins and finished products are an important consideration in determining production entitlements. HPP Manufacturing must account for the cost of (1) transporting resins from resin plants to finishing plants and (2) transporting finished products from finishing plants to GE Polymerland warehouses. Duties incurred in shipping from one pole to another are included in the distribution costs (Table 3).

**Problem Statement and Model Formulation**

The problem of optimizing the HPP supply chain can be stated as follows: given the market demand and price of HPP products, plant capacities, manufacturing costs, additive costs, and distribution costs, determine the optimal production quantities at each plant line that will maximize the total contribution margin for the division. The planning horizon for this problem is four periods (years).
We formulated this problem as a math-programming model (appendix):

\[
\text{maximize } \text{total contribution margin over the planning horizon} \\
\quad = \text{revenues from HPP products} \\
\quad \quad - (\text{manufacturing costs} + \text{additive costs} + \text{distribution costs})
\]

subject to demand constraints, manufacturing capacity constraints, and network flow constraints.

The decision variables are (1) the amount of each resin produced at each resin plant line that will be used at each finishing plant line and (2) the amount of each HPP product produced at each finishing plant.

Table 2: The manufacturing capacities at finishing plant lines were calculated as the maximum amounts of each product that the plant line can make in a year if it were to make that product only. Capacities at the same plant line can differ by product because of different extrusion rates. For each finishing plant line in the first column, the table shows the manufacturing capacity for each product category in 2003 (only partial data is shown because of space limitations). This data was also collected for 2004, 2005, and 2006. Manufacturing capacities at resin plant lines were similarly determined for 2003 through 2006.
Table 3: Distribution costs from resin plant lines to finishing plant lines include duties if the plant lines are in different geographic regions. This data was also collected for 2004, 2005, and 2006. Distribution costs from finishing plant lines to GE Polymerland warehouses were similarly collected for 2003 through 2006.

<table>
<thead>
<tr>
<th>Product Code</th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV_PIE</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>NA_PIE_TBD</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>CAR_PIE</td>
<td>285.0</td>
<td>285.0</td>
<td>285.0</td>
<td>285.0</td>
</tr>
<tr>
<td>CAR_UDF</td>
<td>90.0</td>
<td>90.0</td>
<td>90.0</td>
<td>90.0</td>
</tr>
<tr>
<td>MV_COPOLY</td>
<td>22.5</td>
<td>22.5</td>
<td>22.5</td>
<td>22.5</td>
</tr>
<tr>
<td>MV_PCE</td>
<td>22.5</td>
<td>22.5</td>
<td>22.5</td>
<td>22.5</td>
</tr>
<tr>
<td>BOZ_PCE</td>
<td>150.0</td>
<td>150.0</td>
<td>150.0</td>
<td>150.0</td>
</tr>
</tbody>
</table>

These constraints also permit linear combinations of production rates to enable plant lines to make multiple products, and network flow constraints ensure equality of inflows and outflows at each plant.

Even though the planning horizon is four years, HPP Manufacturing placed no requirements on interdependencies of production decisions from one year to another. That is, decision variables in one year are not to be affected by their values in another year, as this provides the most flexible manufacturing operations. Therefore, we solved the four-year planning horizon problem as four single-year subproblems without any loss in optimality. The mathematical model for a one-year problem has 3,100 variables and 1,100 constraints and is completely linear.

DSS Implementation

We developed the DSS in Excel and used LINGO, a commercial solver, for implementing and solving the math-programming model. Excel was the ideal environment for developing the DSS, given the ubiquity of Excel within GE Plastics and the flexibility Excel provides in structuring information and embedding complex analytics. We designed the user interface using standard Visual Basic controls and implemented the program flow in Visual Basic for Applications (VBA). All inputs and outputs are maintained in worksheets and accessed via a menu (Figure 2). Inputs include product demands and prices, bills of materials, resin
and finishing plants’ capacities, and variable manufacturing and distribution costs. Optimal contribution margin and production by each plant are the main outputs (Tables 4 and 5).

We implemented the math-programming model in LINGO, a commercial optimization solver. We chose LINGO for three reasons: (1) it can easily exchange data with an Excel spreadsheet, (2) it has its own proprietary set notation language for formulating a model, and (3) it can be invoked as a DLL from a VBA module within Excel.

Because the model is linear with no integer variables, the execution time is very fast. The one-year problem solves in less than 10 seconds, and the four-year problem requires about 25 seconds. Because this system is not a transactional system and is used for capacity planning, this solution time is very acceptable.

How the DSS Is Used—A Chronology

The initial version of the DSS included hard constraints to ensure that production equaled demand on the working assumption that the business had enough capacity and would meet all demand to maintain its market share. Early testing of the DSS revealed, however, that capacity might not keep up with rising demand in three or four years, and that could cause infeasible solutions. We revised the DSS so that we could maximize the total contribution margin under a choice of two demand constraints: (1) to meet all demand and (2) to not necessarily meet all demand. By using the first demand constraint option (to meet all demand), HPP could determine whether it has sufficient manufacturing capacity to meet all demand. This option is also appropriate if maintaining market share is important to the business. The second option (to not necessarily meet all demand) is best when rationalizing products is important, because the model decides which products are profitable and should be produced.

HPP Manufacturing first used the system in May 2002 to prepare for S-1 session, an annual long-term planning session in which all GE businesses lay out their business and operating plans for the next four years. The important issues that HPP faced were capacity planning and production entitlements. We collected data for the DSS as follows: GE Plastics provided price and demand data; HPP Engineering developed the bill of materials; plant leaders provided plant production capacities; and HPP Finance provided the manufacturing and distribution costs. Our initial analysis revealed that the resin plants’ capacity was insufficient to meet all demand in the third and fourth years. The business had to determine whether investing in a new plant would be worthwhile.

HPP developed long-term manufacturing plans under two scenarios: (1) using only the existing plants and (2) adding a new resin plant that would operate from the third year onwards. For the second scenario, we successively considered the estimated manufacturing and distribution costs at the three poles for this potential plant. We found that adding a new plant would increase HPP’s total contribution margins and that Europe would be the most cost-effective location for this plant. We presented our analysis to GE Plastics’ senior managers, who approved investing over $200 million in plant and equipment. We expect the plant to begin operations in 2005 and to ramp up to full production by 2007. (We cannot divulge its exact location before a public announcement.)

We next used the DSS for HPP’s S-2 session, a GE-wide one-year planning session, in November 2002 during which HPP Manufacturing laid out its monthly manufacturing plans for 2003. This planning problem was structurally the same as the S-1 planning problem. To use the DSS tool for planning manufacturing for 2003, we simply replaced the yearly data with monthly data. Because we built the tool for four planning periods, we solved the 12-month problem by using the tool successively for four-month problems. For this shorter time horizon, we could not easily change the plant capacities, and thus we did not consider capacity changes.

<table>
<thead>
<tr>
<th>2003 finishing plant production (in '000 lbs)</th>
<th>GFC_Large</th>
<th>AIRCRAFT_Large</th>
<th>ATX100_Large</th>
<th>UFC_Medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>HPP_L4</td>
<td>0</td>
<td>169</td>
<td>2,783</td>
<td>0</td>
</tr>
<tr>
<td>LXF_L29</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CFP_L7</td>
<td>0</td>
<td>0</td>
<td>5,717</td>
<td>0</td>
</tr>
<tr>
<td>COB_NR</td>
<td>0</td>
<td>416</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>SHA_L1</td>
<td>225</td>
<td>0</td>
<td>2,196</td>
<td>546</td>
</tr>
</tbody>
</table>

Table 4: The DSS determines the optimal production entitlements for all finishing and resin plant lines. For each plant line, the tables show how much quantity of each product will be produced. We display only partial data for 2003 in the table because of space limitations; however, we also determined this information for 2004, 2005, and 2006.

<table>
<thead>
<tr>
<th>2003 resin plant production (in '000 lbs)</th>
<th>PEI</th>
<th>COPOLY</th>
<th>PCE</th>
</tr>
</thead>
<tbody>
<tr>
<td>MV_PEI</td>
<td>0</td>
<td>0</td>
<td>14,539</td>
</tr>
<tr>
<td>NA_PEI_TBD</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>CAR_PEI</td>
<td>3,640</td>
<td>46,380</td>
<td>0</td>
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<tr>
<td>CAR_UDF</td>
<td>4,000</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MV_COPOLY</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>MV_PCE</td>
<td>0</td>
<td>20,000</td>
<td>0</td>
</tr>
<tr>
<td>BOZ_PCE</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
In 2003, we expanded the bill of materials but the model structure remained intact. HPP now uses the DSS routinely for S-1 and S-2 planning.

Benefits
We developed the decision-support tool to support GE Plastics’ switch to global-based manufacturing operations. It made the change to obtain three primary benefits: (1) to better match demand and production capacity, (2) to reduce manufacturing costs by centralizing production and by making products where they are cheapest to produce, and (3) to reduce raw material costs by sourcing them globally.

HPP’s global manufacturing leader, the primary user of this DSS, uses the tool in two ways: (1) as a four-year capacity planning system that evaluates scenarios of product demand and capacity changes to determine production entitlements and (2) as a one-year manufacturing planning tool that determines monthly plant-production requirements for existing plants. The DSS provides these other benefits:

— It analyzes the return on investments in plant and equipment, for example, it produced the analysis that was crucial in determining the benefits of expanding the resin production capacity.
— It maximizes the total contribution margin for the HPP division.
— It facilitates raw material procurement and personnel planning by projecting long-term production requirements for raw materials and personnel.
— When demand exceeds capacity, the system determines which products contribute the most to revenue and thus should be produced. Should demand for high-margin products increase and require more capacity, the DSS will identify which products to scale back.

This DSS has been a success at the HPP division since its introduction in 2002. As a result, other GE Plastics divisions are adapting it for their supply-chain planning.

Appendix

Model Formulation

Indices

\[ p = \text{HPP product, } p = 1, \ldots, 24. \]
\[ r = \text{resin, } r = 1, \ldots, 3. \]
\[ c = \text{additive, } c = 1, \ldots, 2. \]
\[ m = \text{market, } m = 1, \ldots, 3. \]
\[ f = \text{finishing plant line, } f = 1, \ldots, 21. \]
\[ k = \text{finishing plant line, } k = 1, \ldots, 8. \]
\[ t = \text{planning period, } t = 1, \ldots, 4. \]

Decision Variables

\[ x_{pfmt} = \text{amount of product } p \text{ produced at finishing plant line } f \text{ for market } m \text{ in year } t. \]
\[ y_{rktf} = \text{amount of resin } r \text{ produced at resin plant line } k \text{ for finishing plant line } f \text{ in year } t. \]
\[ z_{cft} = \text{amount of additive } c \text{ needed at finishing plant line } f \text{ in year } t. \]

Parameters

\[ D_{pmt} = \text{demand for product } p \text{ in market } m \text{ in year } t. \]
\[ N_{pmt} = \text{selling price of product } p \text{ in market } m \text{ in year } t. \]
\[ R_{pr} = \text{use of resin } r \text{ per pound of product } p. \]
\[ C_{pc} = \text{use of additive } c \text{ per pound of product } p. \]
\[ A_{cft} = \text{cost of additive } c \text{ per pound at finishing plant line } f \text{ in year } t. \]
\[ S_{fmt} = \text{transfer and duty cost per pound from finishing plant line } f \text{ to market } m \text{ in year } t. \]
\[ T_{kft} = \text{transfer and duty cost per pound from resin plant line } k \text{ to finishing plant line } f \text{ in year } t. \]
\[ U_{pft} = \text{variable cost of producing product } p \text{ at plant line } f \text{ in year } t. \]

Financial summary

<table>
<thead>
<tr>
<th></th>
<th>2003</th>
<th>2004</th>
<th>2005</th>
<th>2006</th>
</tr>
</thead>
<tbody>
<tr>
<td>Revenue</td>
<td>317,007,003</td>
<td>379,322,083</td>
<td>547,470,513</td>
<td>607,277,282</td>
</tr>
<tr>
<td>Total demand (in '000 lbs)</td>
<td>62,203</td>
<td>74,724</td>
<td>104,783</td>
<td>115,675</td>
</tr>
<tr>
<td>Average selling price per lb ($)</td>
<td>7.64</td>
<td>7.61</td>
<td>7.84</td>
<td>7.87</td>
</tr>
<tr>
<td>Finishing plant conversion costs</td>
<td>14,995,291</td>
<td>17,020,891</td>
<td>22,814,698</td>
<td>23,747,437</td>
</tr>
<tr>
<td>Resin plant total variable cost</td>
<td>88,810,968</td>
<td>91,305,982</td>
<td>130,088,733</td>
<td>137,682,403</td>
</tr>
<tr>
<td>Raw material costs</td>
<td>13,329,531</td>
<td>15,545,698</td>
<td>20,732,302</td>
<td>22,170,743</td>
</tr>
<tr>
<td>Finishing to market costs</td>
<td>2,961,342</td>
<td>3,484,267</td>
<td>4,912,735</td>
<td>5,129,464</td>
</tr>
<tr>
<td>Resin to finishing costs</td>
<td>508,009</td>
<td>1,389,658</td>
<td>1,742,111</td>
<td></td>
</tr>
<tr>
<td>Total cost</td>
<td>121,633,423</td>
<td>130,773,698</td>
<td>183,250,952</td>
<td>190,793,695</td>
</tr>
<tr>
<td>Total contribution margin</td>
<td>195,373,580</td>
<td>248,548,384</td>
<td>364,219,561</td>
<td>416,483,587</td>
</tr>
<tr>
<td>Contribution margin as percent (%)</td>
<td>50</td>
<td>50</td>
<td>53</td>
<td>53</td>
</tr>
</tbody>
</table>

Table 5: The financial summary report shows revenue, cost, and total contribution margin for each year. Other elements include total demand met, average selling price, and various manufacturing and distribution cost components.
\[ V_{kr} = \text{variable cost of producing resin at plant line } k \text{ in year } t. \]
\[ P_{pf} = \text{amount of product that can be produced at finishing plant line } f \text{ in year } t. \]
\[ Q_{kr} = \text{amount of resin } r \text{ that can be produced at resin plant line } k \text{ in year } t. \]

**Constraints**

A choice of

(a) meet all product demand:
\[
\sum_{f} x_{pf} \geq D_{pmt} \quad \text{for all } p, m, t. \tag{1a}
\]

(b) or, need not meet all product demand:
\[
\sum_{f} x_{pf} \leq D_{pmt} \quad \text{for all } p, m, t. \tag{1b}
\]

Resin requirements:
\[
\sum_{k} y_{krf} \geq \sum_{p} \sum_{m} R_{pr} x_{pf} \quad \text{for all } r, f, t. \tag{2}
\]

Feed requirements:
\[
z_{ct} \geq \sum_{p} \sum_{m} C_{ct} x_{pf} \quad \text{for all } c, f, t. \tag{3}
\]

Finishing plant line production constraints:
\[
\sum_{p \in \{p: P_{pf} \neq 0\}} \frac{1}{p} \sum_{m} x_{pf} \leq 1 \quad \text{for all } f, t. \tag{4}
\]

Resin plant line production constraints:
\[
\sum_{r \in \{r: Q_{kr} \neq 0\}} \frac{1}{Q_{kr}} \sum_{f} y_{krf} \leq 1 \quad \text{for all } k, t. \tag{5}
\]

HPP revenues:
\[
\sum_{t} \sum_{p} \sum_{m} N_{pmt} D_{pmt}. \tag{6}
\]

Finishing plant lines’ production costs:
\[
\sum_{t} \sum_{f} \left( \sum_{p} U_{pf} \sum_{m} x_{pf} \right). \tag{7}
\]

Resin plant lines’ production costs:
\[
\sum_{t} \sum_{k} \left( \sum_{r} V_{kr} \sum_{f} y_{krf} \right). \tag{8}
\]

Additive costs:
\[
\sum_{t} \sum_{c} \sum_{f} A_{ctz_{ct}}. \tag{9}
\]

Transfer cost for finished products:
\[
\sum_{t} \sum_{f} \sum_{m} \left( S_{fmt} \sum_{p} x_{pf} \right). \tag{10}
\]

Transfer cost for resins:
\[
\sum_{t} \sum_{k} \sum_{f} \left( T_{kft} \sum_{r} y_{krf} \right). \tag{11}
\]

**Objective Function**

maximize \[ \text{total contribution margin} \]

\[ = \text{HPP revenues} - (\text{finishing and resin plants production costs} + \text{transfer costs} + \text{additive costs}) \]

\[ = \sum_{t} \sum_{p} \sum_{m} N_{pmt} D_{pmt} - \sum_{t} \sum_{f} \left( \sum_{p} U_{pf} \sum_{m} x_{pf} \right) - \sum_{t} \sum_{k} \left( \sum_{r} V_{kr} \sum_{f} y_{krf} \right) - \sum_{t} \sum_{c} \sum_{f} A_{ctz_{ct}} - \sum_{t} \sum_{f} \sum_{m} \left( S_{fmt} \sum_{p} x_{pf} \right) - \sum_{t} \sum_{k} \sum_{f} \left( T_{kft} \sum_{r} y_{krf} \right). \tag{12} \]

Timothy Rash, HPP Global Business Leader, GE Plastics Mt. Vernon, Inc., 1 Lexan Lane, Mt. Vernon, Indiana 47620-9364, writes: “It is my pleasure to write this letter in support of the GE Research team’s submission of their work for The Daniel H. Wagner Prize for Excellence in Operations Research Practice. The team has commissioned a math-programming-based fulfillment network decision support system (DSS) for the High Performance Polymer (HPP) business. The DSS models HPP’s global two-level manufacturing operations as a mathematical model that maximizes the total contribution margin for the business, defined as revenue from sale of HPP grades produced minus the manufacturing and distribution costs. In doing so, the model considers constraints such as plant capacities, plant yields, and production rates, so that the most profitable demands are met. The DSS is implemented in Microsoft Excel, and uses a commercial solver to execute the mathematical model without requiring any user involvement.

The fulfillment model was first used as a supply chain design and analysis tool for HPP’s long-term planning session in May 2002. In this annually held session, we make major decisions on product rationalization and Plant & Equipment (P&E) investments that impact our business for the next three years. On this occasion, we used the tool to analyze the impact of planned capacity changes in existing plants and a new plant with yet to be determined capacity and location. By testing alternative locations and estimated manufacturing costs, we were able to determine the most cost-effective location for the plant and...
the required manufacturing capacity. Pending official Company announcement, we cannot yet disclose the plant location, but suffice it to say that the P&E investment is in hundreds of million dollars.

“After the long-range planning session, we focused our attention on short-term (one-year) planning session held in October of 2002. To achieve this, we successively used the tool to analyze each quarter using monthly data. The resulting monthly schedules are driving plant production in 2003.

“The use of this DSS in HPP’s long-term planning session was so well received by GE Plastics’ Corporate executives that it was termed a best practice, and now other divisions with similar supply chains are adapting this tool for their own supply chain design and analysis. For HPP, this DSS is now a perpetual long-term design and short-term planning tool. As you can imagine, we are extremely pleased with the work of GE Research team. Please feel free to contact me if you need any additional information.”