Case 4: Resource Allocation at Applichem

(This case is adapted from the "Applichem (A) (Abridge)" HBS Case 9-694-030)

It was early morning in December 2010, and John Applewood, Director of Operations at Applichem, was staring at a memo from his boss, Ken Williams, regarding the profitability of the Release-Ease Chemical.

> To: John Applewood
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> From: Ken Williams
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> Subject: Future of Release-Ease Chemical
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> I just completed a review of our product lines, and I am very concerned about the viability of the Release-Ease Chemical (REC) in our division. Although we are the primary supplier of REC to other plastic companies, the market for REC has remained constant over the past few years, with few growth opportunities for revenue.
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> The four plants that we operate have different capacity and operating efficiency. I am wondering if it might make sense to consolidate the production into a few facilities, and shipped the products to the different markets. This might reduce the total annual production cost. Can you take a look at this? We really need to wring out more profits from the operation. The annual production planning meeting is coming up later this week. It would be great if I can get your inputs before the meeting.

John had been with Applichem for over 30 years, right after he graduated from college. He had moved up the rank, and for the past 10 years, had been responsible for the manufacturing of REC product at Applichem. This is one of the main products manufactured by the company, and John has developed closed relationship with the plant managers and workers. As he read this e-mail, he was worried that if nothing was done, his division (and his job) might disappear.

Business Background

Applichem was a manufacturer of specialty chemicals founded in Chicago just before World War II. Developed in 1952, Release-Ease Chemical (REC) was a dry powder specialty chemical that is added to a plastic molding compound, so that the plastic can release easily from metal molds after compression molding.

Making molded plastic parts is much like making molded jello. Both jello and the plastic molding compound are hot liquids when poured into the mold; both harden as they cool. Both tend to leave residue on the mold after they are unmolded. However, washing a jello mold is easy, and the mold is rarely needed again immediately. But

molds for plastic parts are precision stainless steel; they can be difficult to clean; and they are used repeatedly, with unmolding and cleaning often the bottleneck in the molding process.

REC was a chemical to be added in low concentration to the plastic molding compound during its manufacture so that the molded parts would be easier to separate from the mold and would leave the mold cleaner. REC was widely used in molding plastic parts.

Applichem had held the patent for REC, and the product family had been a steady sales and profit generator for the company through 2010. However, Applichem had done little focused research on the Release-ease product or process after about 1953. In 2010, Applichem's market research group conducted a study, and concluded that there will be little increase in worldwide demand for REC during the next ten years. In 2010, REC sold at an average price of $1.40 a pound. REC sales by region, production by each of the four plants, as well as exports and imports by region (all in millions) are given in the following table:

Market	Sales	Plants	2010 Production	Exports to Other Region	Imports from Other Regions
North America	29.0	Gary, Indiana (USA)	14	0.0	15
Western Europe (incl. Middle East and Africa)	20.0	Frankfurt (Germany)	37.9	17.9	0.0
Latin America	12.1	Mexico	17.1	5.0	0.0
Pacific and Rest of World	11.9	Sunchem (Japan)	4.0	0.0	7.9
Total	73.0		73.0	22.9	22.9

*** This information is obtained from Actual Manufacturing data.

Applichem essential has a monopoly on REC-type chemicals. Its strongest competitor was a large U.S.-based chemical company whose only plant for making a close substitute for REC was located in Luxembourg. Its sales in Europe were strong and it made some export sales to the U.S. and Latin America. But Applichem had by far the largest market share and the mystique associated with having the first patented product.

The Manufacturing Plants

The Gary plant was managed by the North American area. The plant was located in Gary, Indiana, (just outside Chicago) in a neighborhood where immigrants from Eastern Europe had settled during the early twentieth century. The plant was founded in 1905 and purchased in 1951 by Applichem as the company's first large manufacturing facility.

REC was the first product Applichem manufactured in Gary, and the process had remained roughly the same. It had a REC design capacity of 16 million pounds a year, and around 60 people manufactured 14.0 million pounds

The Frankfurt plant supplied customers located in Europe, the Middle East, and Africa as well as other Applichem plants. Although its design capacity for REC was 37 million pounds a year, it made about 37.9 million pounds of REC last year, through a combination of a very expensive overtime and a one-time purchase of additional capacities in nearby locations. For 2011, John would like to make sure that the Frankfurt does not exceed its design capacity of 37 million. The plant had two processes for manufacturing Release-ease: one installed between 1971 and 1974 and one installed in about 1961, with later major modifications to increase capacity. The processes featured computer control of the first process step and extensive solids recovery and waste treatment.

The Mexican plant was part of a wholly owned subsidiary of Applichem. It was managed by Mexican nationals, who reported to the vice president of the Latin American Area. It supplied the Mexican market and in the early 1980s began to supply some markets in the Far East. The plant processed about 17.1 million pounds of Release-ease during 2010, and had a design REC capacity of 18 million pounds a year. It was similar in design to the Gary plant.

Sunchem was Applichem's 50% Japanese joint venture, which owned and operated a manufacturing plant in Japan for REC and one other product for the plastics industry. It was managed by Japanese nationals and reported to Applichem's Pacific Area. It was founded in 1957 and had supplied the REC requirements of Japanese customers after that. Its manufacturing process had been redesigned in 1969, when some automation and waste recovery systems had been introduced. The plant had a rated capacity of 6 million pounds a year, and it produced 4 million pounds in 2010. Within Applichem the Japanese plant was generally thought to be technically excellent. Employees there did more development work than in other plants: they had a product test laboratory, a plastics engineering lab and a workers' dormitory for single men.

The Business Challenges

As John was reading the memo, he began to think through the analysis that he needs to present in the upcoming operation planning meeting, in order to improve the efficiency of the plants. A major concern in his mind is the fluctuating exchange rates across the different plant locations, and how they might impact the overall cost. In addition, the inflation rate in Japan is nearly zero, while it’s quite significant in Mexico. John is wondering how all of these parameters will impact his operations.

Data

Here is the 2010 cost of labor and raw materials for making one pound of REC at different plant (in US dollars):

Cost per pound of REC	Mexico	Germany	US	Japan
Raw Material	$0.7505	$0.5300	$0.6083	$0.8073
Labor	$0.1370	$0.1591	$0.2216	$0.2814

The transportation cost (per pound of REC in 2010 US dollars) is given in the following table:

Markets\Plants	Mexico	Germany	US	Japan
Latin America	$0.0750	$0.1290	$0.1150	$0.1280
Western Europe	$0.1110	$0.0200	$0.1010	$0.1200
North America	$0.1100	$0.1050	$0.0500	$0.1250
Asia Pacific	$0.1410	$0.1330	$0.1260	$0.0600

John has also collected the following historical data on the exchange rate (for 1 US dollar)

Year	Peso	Euro	US	Yen
2002	9.6590	1.0617	1.0000	125.2723
2003	10.7904	0.8854	1.0000	115.9288
2004	11.2848	0.8049	1.0000	108.1388
2005	10.8950	0.8047	1.0000	110.1134
2006	10.9020	0.7971	1.0000	116.3021
`2007	10.9292	0.7309	1.0000	117.8078
2008	11.1468	0.6832	1.0000	103.4496
2009	13.5122	0.7198	1.0000	93.6051
2010	12.6275	0.7553	1.0000	87.7760

Finally, here is the annual inflation rate for each of the four countries where Applichem has an operating plant.

Year	Mexico	Germany	US	Japan
2002	4.677%	1.267%	1.182%	-1.082%
2003	4.696%	0.626%	2.058%	-0.099%
2004	4.285%	2.073%	3.052%	-0.398%

2005	4.599%	1.218%	2.803%	0.100%
2006	2.996%	1.805%	4.167%	-0.100%
2007	3.948%	2.069%	2.691%	0.000%
2008	4.947%	2.992%	4.175%	0.799%
2009	5.978%	0.000%	-1.281%	-0.099%
2010	3.916%	1.218%	2.021%	-1.190%

Action Plan

Ken Williams is concerned about the different capacity and operating efficiency and he wants to have a consolidated productions plan. John Applewood has to submit a report that will show the best solution for production plan. His action plan is to do the following,

1. (5 points) By averaging the historical data in each country, determine the estimated inflation rates and exchange rates in each country for 2011.

2. (15 points) Use the inflation and exchange rate forecasts from Question 1 to determine the following estimated costs in 2011
    a. Cost of raw material per pound of REC *in US Dollars for each country*
    b. Labor cost per pound of REC *in US Dollars for each country*
    c. Transportation cost per pound *in US Dollars between each of the four markets served by Applichem*

3. (25 points) Build a linear programming that determines the production of REC in each plant in 2011 and the amount of REC shipped to each of the 4 markets from each plant, in order to maximize Applichem's total profit.
    a. Use Excel Solver to compute the answer to your linear program. Assume that the revenue per pound of REC in 2011 will be $1.46 US Dollars. Report the optimal production and shipment schedules for each plant. How does this solution differ from production schedules in 2010? Why?

    b. Consider the baseline profit based on the assumption that each plant produces (up to its capacity) only to serve its local market, and we do not allow any import or export of REC. Compare your profit from part (a) to the baseline profit.

4. (10 points) Applichem is considering a proposed marketing campaign in the Asian Pacific market. It is estimated that the demand in this market can increase by 3 million pounds. The campaign will cost about $0.4 million. Based on the sensitivity report from 2011 production schedule, do you recommend this campaign to the company? Provide detail reasoning to support your argument.

5. (15 points) The estimate for REC in 2011 ($1.46 per pound) may not be reliable. Appichem worries that any change of this revenue figure might change the optimal production schedule by your LP. Specifically, if the price is 1.56 instead, what will the optimal production schedule and profit be? Also, what if the price drops to 1.36? Can you answer these from the sensitivity report? Detail your reasoning.

Team extension

6. Please choose one of the following topics:
   a. Besides LP, is there any comparable method that can help the company to plan for the production schedule?
   b. In the setup of LP, all information is assumed to be fixed. Clearly, that's not always true in reality. Discuss the variability in the production planning and propose a solution to deal with the uncertainty.