Global Supply Chain Management Initiative presents

2010 Global Supply Chain Management Conference & MBA Student Case Competition

Powering the Global Supply Chain

February 12th, 2010 ● Purdue Memorial Union ● Purdue University

Presenters include: Keynote Address Saint-Gobain Containers
EnerDel   Federal Express   Great Lakes WIND Network   John Deere Wind Energy
Purdue University Renewable Energy Extension Program

MBA Case Competition Phase I

Case

Sustainable Manufacturing – Message in a Bottle

February 2010

Case written by: Professor Ananth V. Iyer

Susan Bulkeley Butler Chair in Operations Management
DCMME/GSCMI Center Director

Krannert School of Management
Purdue University, West Lafayette, IN 47907
aiyer@purdue.edu

Hank Bilders, President of SGS Glassworks had cleared out his schedule for Friday and the rest of the weekend. He had committed to a deadline of January 18th for a proposal to SGS's board, which in turn, meant that his recommendation was due imminently. Spread before him were summaries and detailed analysis from several independent consultants – each espousing a novel strategy for SGS to position itself as an industry leader in sustainable manufacturing. The question remained – *what should SGS do to manage its supply chain and surge ahead as a leader in sustainable manufacturing?*

About SGS

SGS was a market leader in the manufacturer of bottles and other glass based products. With several decades of manufacturing experience, the company was regarded as a thought leader in the industry. SGS management pushed the industry to adopt innovative manufacturing approaches, identify ways to minimize environmental impact, and reduce breakage through standardized pallets and handling methods etc.. Over the years, the plastics industry had made significant strides in shifting beverage manufacturers from using glass to using plastic, however, times were changing and the tide was set to turn once more.

SGS Plant Network

The SGS manufacturing network consisted of five plants spread throughout the United States. These plants were located in Madera, CA, Waxahachie, TX, Dunkirk, IN, Henderson, NC and Milford, MA. The spatial locations of these plants are shown in Figure 1. The current production region for each plant is shown in Figure 2.
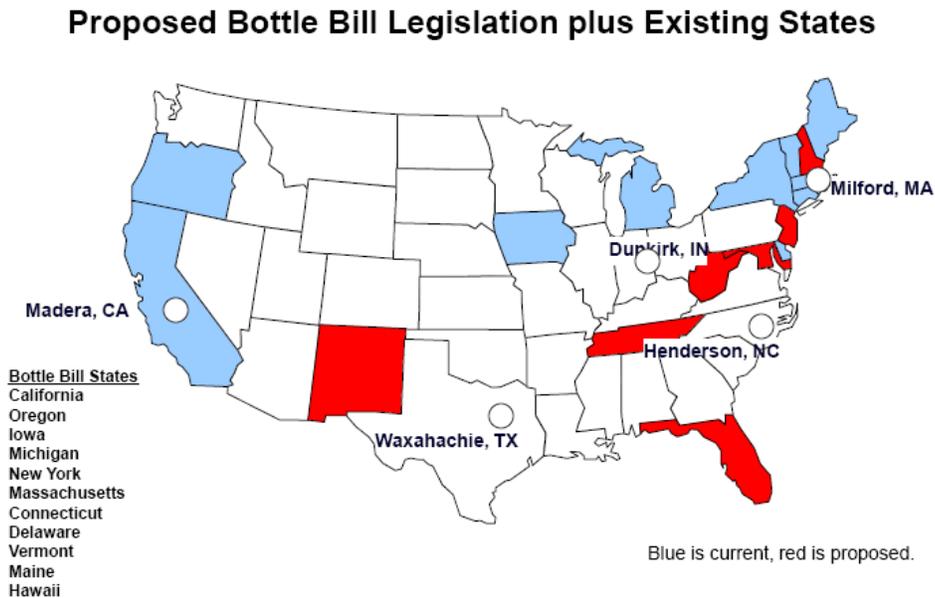

Proposed Bottle Bill Legislation plus Existing States

Figure 1

Figure 2 shows the US population divided into five zones with their associated population levels.

U.S. Population by Region

63,941,001

68,028,559

63,837,769

63,300,793

42,977,1111

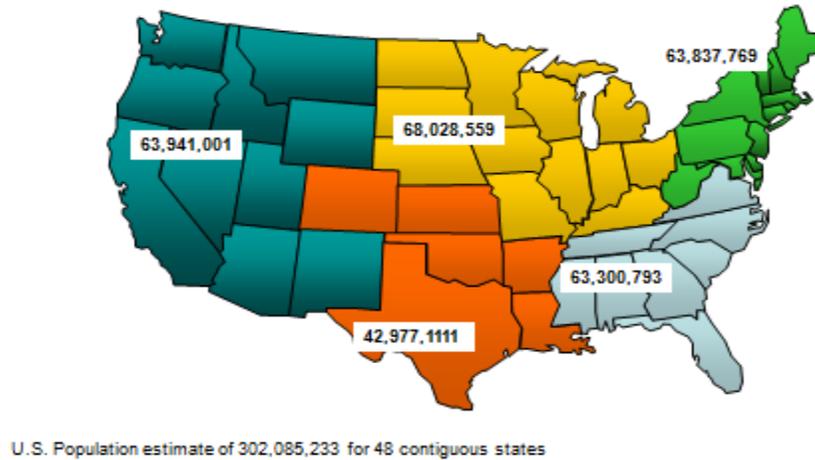U.S. Population estimate of 302,085,233 for 48 contiguous states

Figure 2

Figure 3 shows the consumption of beverage glass material (bottles) in each of the five regions.

Potential Beverage Glass Material by Region
(based on population)

1,777,589 MTons

1,891,225 MTons

1,774,719 MTons

1,759,791 MTons
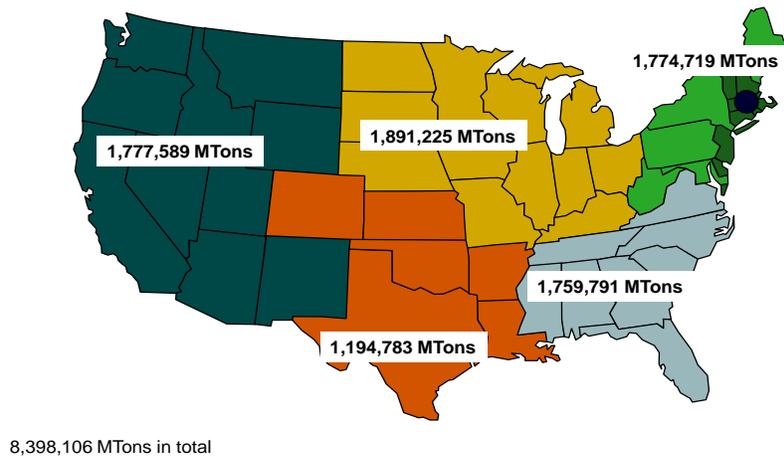
1,194,783 MTons

8,398,106 MTons in total

Figure 3

The average recycling rates by state would be estimated based on whether or not the state has a bottle bill. Figure 1 highlights the next set of expected states that plan to adopt the bottle bill.

Hank expected these recycling rates to increase as the bottle bills states increased in each region.   Also, assuming that bottle usage rates per capita were constant, he realized that he could compute available recycled content for each state based on their populations.

Each plant had different furnace technological constraints, energy availability, level of automation, labor skills, etc. However, the current approach distributed the available recycled glass to maintain the input raw material mix the same across all plants. The current production at each plant covered the demand in its region. Assuming an average market share of 35% for SGS in all regions, the associated production could be estimated. Finally, the distance travelled to SGS's customer destinations was estimated as the median distance in the production region.

The manufacturing capacity of each plant was such that it could be expanded to cover the demand of at least two regions if required. The regions are the five regions in Figure 2. But what if some of the input variables were changed at each of the plants, how would it affect the associated average manufacturing cost and optimal production?

The Impact of Cullet use on Costs

Cullet, often referred to in reference to recycled glass, is used as input to make new glass bottles. As a starting point, one of Hank's accountants had created the following list of potential ways that use of cullet could impact the cost structure of the supply chain.

Saves Energy: using cullet allows us to reduce energy costs by 2 to 3% for every 10% of cullet used in the manufacturing process.

Decreases by-products: use of recycled glass is a closed-loop process creating no additional waste or by-products and is indefinite.

Saves raw material and the carbon requirements to produce: For every ton of glass recycled, over a ton of raw materials are saved, including 1300 pounds of sand, 410 pounds of soda ash, and 380 pounds of limestone.

Reduces landfill dependence: avoids costs associated with disposal; however this cost varies by the location of the waste bottles.

Lessens greenhouse gas emissions: use of 10% recycled glass results in a 6% decrease in nitrous oxide and a 9.5% reduction in raw materials.

Increases Furnace life: cullet requires less heat to produce glass and the life of a furnace is directly related to the heat applied to melt raw materials; even if the cost of cullet is high, the downstream effect of a negative initial cost element is positive considering all factors. The company can produce the same tonnage with less energy and maximize capital by extending the furnace life.

Customer Requirement & Marketing Tool: customers want to know carbon usage to meet their requirements and as a marketing tool the organization can sell the product perhaps at a premium.

Soda Ash Price has doubled in last 5 years: cullet is an offset as cullet inflation lags raw batch inflation.

(There is no effect on machine life due to cullet. The positive primary impact is in energy, environment, batch cost and furnace life.)

Recycling Options

Hank Bilders reminisced that back before World War II, it was common to recycle beer bottles – the recycle rate was over 80%. In fact, bottles were reused over 50 times and recycling was the norm. Hank listed several possible options to increase the supply of recycled bottles. These included:

(a) **One source recycling** – this refers to increasing the recycle rate by collecting all the waste as one bag from citizens and using centralized facilities to do the separation. Several studies that recommend that the economics of such garbage collection schemes would increase the recycle rate by simplifying the process for households. One of the issues that were still unresolved was whether the quality of the recycled glass material would be acceptable for glass manufacturing plants.

(b) **Simplifying the process of getting refunds using Technology**: Tomra (see URL http://www.tomra.com/default.asp?V_ITEM_ID=380) was one company that had developed a unique approach to separate plastic or glass. Their technology would separate the inputs provided by customers using laser detection. This detection would allow instant determination of the recycled material and issue refunds to the customer.

(c) **Grass roots Movements to increase recycling rates**: There were several grass roots movements aimed at increasing the recycle rates. Some states, such as Indiana, started a "Sustainindy" movement to encourage citizens to care about the environment. The approach galvanized students in schools, citizens in general and successfully generated recycled material.

There were education initiatives being generated by glass manufacturing companies such as Saint-Gobain Containers. One such initiative created characters such as "Captain Cullet" and "Little Gob". These movies were distributed to schools and the general public as a way to encourage recycling among the population. Should SGS push for similar education initiatives to increase consumer awareness?

(d) **Bottle Bill**: There was tremendous variation in the recycle rate across states. The rate in California was close to 80%, while the average rate was 27%. Bottle bill states mandated that producers collect a fee from consumers which would then be refunded upon recycling. While the majority of states had bottle bills in the 1980s there had been a significant drop off and currently only 11 states had bottle bills. Studies showed differences in the recycle rate between bottle bill and non-bottle bill states.

However, there were also differences in recycling across container usage. For example, wine bottle recycling stood at an average of 15%. Recycling by pubs and other establishments was also significantly

lower than the national average. The bottle bills also listed the specific products that were covered by the bill and did not include juices and water – these were emerging users. There was push back from manufacturers who worried that increased prices would drive down demand for their products.

(e) **Reuse bottles after washing**: Some environmental groups suggested that it was a lot better to wash and reuse bottles than to break it down as cullet. One company, Wine Bottle Recycling LLC, planned to supply wine manufacturers using a state of the art technology to collect, sort, de-label, wash, sterilize and repackage wine bottles for resale at a rate of 72,000 bottles per hour from a single facility. Given that the green wine bottles were historically difficult to recycle they had to be separated before use, such processes focused on a particular industry. The CEO of the company (Wine Bottle Recycling LLC) claimed that the energy use was 4.23% of the energy required to produce a new bottle.   Hank was aware that such disruptive approaches would cannibalize sales for SGS – but he had to either join in or find an effective alternative.

(f) **Green Mountain Glass LLC**: One company that announced a new technology was Green Mountain Glass LLC. The company aimed to permit mixed cullet from green and clear bottles to produce new glass. The technology would enable an easier recycling loop whereby all bottles could be mixed and used to form cullet. Given that in many countries - such as the UK, the green glass was not feasible to use for local glass production, the company claimed that such technologies would significantly impact recycling rates and increase useable cullet supply to glass manufacturing plants.

(g) **Penalize those who do not recycle:** Current ordnances planned in San Francisco would penalize residents of the region who do not recycle material such as glass, plastic and newspapers. The planned penalties were around $500. The hope for San Francisco was to increase recycle rates from the current levels of 70% to a level of over 75%.

Hank had access to the detailed reports and/or URLS that contained reports for each of these options. He was also aware that he had to choose which of the options made the most sense for SGS to support (with human capital and funding) and was consistent with the company's goals. He was also aware that unless SGS provided leadership, the industry would not be able to claim significant advances in sustainable manufacturing. While influencing recycling rates and increasing sustainable manufacturing was important, Hank was reluctant to wade into a political minefield whereby business growth of downstream customers were at odds with cost savings by upstream producers.

Avoiding future tax liabilities

One of the studies completed for SGS by S. Ash and Associates provided a life cycle cost analysis of changing to cullet. Their analysis suggested that the cost of acquiring cullet and the ability to raise usage of bottles by downstream customers were critical elements of a successful transition to use of cullet. The production rates for each of the five plants are already set based on demand in the region supplied by the plant (Figure 2).   But Hank also knew that public sentiment for sustainable manufacturing suggested that manufacturers would be hit with tax penalties for producing products that were not easily recyclable. Under that model, the impact of a manufacturer's product on landfill costs would be

reflected on the manufacturer's tax bill. Anticipating such effects was part of Hank's strategic approach to decision making.

Choices, choices, choices

There were thus two significant changes that needed to be considered – increasing the supply of cullet and adjusting manufacturing at each plant based on supply. Increasing cullet availability at reasonable price points again required many of the ideas discussed earlier to be analyzed. Hank was well aware that wading into a political battle, particularly given the current economic environment, was a risky proposition. Retailers were not interested in raising retail prices even if it meant that customers could get their money back by recycling. Also, political representatives were aware that they had to consider which products would be subject to the influence of the bottle bill. As an example, several states had chosen specific products and not others, while all used glass bottles. Beverage manufacturers were aware that the increased costs at retail, despite it being a deposit, could affect their demand. Thus, any scheme that let them free ride the recycling would give them a competitive edge while keeping the customer oblivious. All this jockeying for coverage had created customer confusion when recycling bottles.

Finally, while schools were quite happy to talk about recycling, there were worries about whether the class discussions about relative packaging choices would reflect the sophisticated analysis that was necessary to make the right decision. Was it as simple of shifting from plastics or aluminum cans to bottles? Were the breakage rates the same across these different packages? In addition, there were some who were skeptical of the entire recycling movement in general. All of these voices would compete for airtime if a bottle bill discussion were happen. Some states had just pushed decisions down the road (see NY state decision).

What would be the best approach for SGS that put them on a path to increased sustainability? How could the company demonstrate leadership in the industry and regain the bottle demand lost to plastics? Could approaches to become sustainable enable local job creation and thus be economically sustainable? Could incentives be created across supply chain members to do their best for the overall supply chain to be eco-friendly? Was there a need for government intervention to push the supply chain members on to a new manufacturing plateau that is more eco-friendly?

Hank pondered all of these issues as he started outlining his presentation. He was convinced that he needed persuasive arguments, quantitative estimates and implementable approaches to succeed within SGS. He wanted help in a hurry.

Downstream Demand

There were several specific downstream customers who were focused on sustainable products and packaging. The organics industry had customers who appreciated the use of recycled material. Websites that pushed such material had manufacturers who offered a premium price for bottles with high recycled content. The product "Love Water" focused on use of glass bottles to carry water and promoted the recyclable nature of glass. (Full disclosure at the company website was that investigation of the manufacturing showed a 30% recycled glass use – the company was working with bottle manufacturers to identify sources that could be certified to have high recycled glass content). But the location of these producers was different from the plants that had access to high recycled bottle sources.

Should SGS transport the cullet to the plant closest to these downstream demand sources? Should the finished product be transported to the customer? Or, should the company use these sales opportunities to drive recycling as a local job creation device? Alternately, the company could choose to expand in the region where recycled content decreased input costs and cut production in other locations.

Adjusting the Production Network

The current approach at SGS was to provide a uniform raw material cost – that meant that all plants shared the recycled glass collected. This also meant that often cullet was transported from regions where large quantities were available (high cullet regions) to plants in regions (primarily in the Midwest and East) where recycling rates were low (low cullet regions).

One approach that was suggested by the Network Planning group within SGS was to adjust manufacturing to maximize the use of recycled glass closest to the source. Such an approach would change the production costs across plants. However, it would decrease raw material acquisition cost for some plants. But those plants, with a higher recycled content, could be used to showcase the benefits of recycling and its consequent impact on plant competitiveness. Should SGS switch to such an approach?

A second approach was to choose plant product mix taking into account downstream demand sources for bottles based on the extent of recycled glass used in production. Such an approach would use the recycled glass in plants that could effectively supply to downstream manufacturers who preferred recycled glass (such as "Love Water" and organics discussed earlier).

A third approach was to include the commitments made to labor groups at each plant so that plant competitiveness would be balanced with labor capacity utilization guarantees.

But there was another school of thought that suggested that plant operational decisions should be decentralized and plants operated as individual profit centers. Such a scheme would permit plants to compete for customers, raw material and operations so as to be profitable.

A Strategic Approach

Hank had picked up a copy of the book by Andrew Winston (titled "Green Recovery – Get Lean, Get Smart, and Emerge from the Downturn at the Top") at the airport bookstore during one of his frequent trips. The book outlined ways (see the URL http://www.andrewwinston.com/blog/archives.php for examples) that companies can look across their supply chain for opportunities to be sustainable as well as for opportunities to grow and survive amidst economic downturns. It outlined approaches for companies to view themselves as "solution providers" by adjusting their supply chain, their products and their services. He also suggested using heresies (such as "Can a Plane fly without Jet Fuel", "Can we send no waste to a Landfill") as a way to stimulate strategy formation. He wondered if any of the ideas in the book could be used as a theme for all of the decisions across SGS.

Case Support Reference Table

Reference Name	URL
Tomra	http://www.tomra.com/default.asp?V_ITEM_ID=380
Green Recovery Book	http://www.andrewwinston.com/blog/archives.php
US Dept. of Energy	http://apps1.eere.energy.gov/industry/saveenergynow/partners/plant.cfm/esa=ESA-139-4
Saint-Gobain Containers	http://www.sgcontainers.com/index.nsf http://www.sgcontainers.com/index.nsf/vwNV4/92863CCA6A836AEC85256C3B004898D5?OpenDocument
Waste Age	http://wasteage.com/mag/waste_profiles_garbage_glass_2/index.html
Kids recycling video	http://www.youtube.com/watch?v=xTW9xqcb2Uw
Events to create a buzz about recycling glass	http://www.gpi.org/news/2009/oct/mail.htm
Focused segments for glass packaging	http://www.keepitorganic.org/2009/12/15/according-to-packaging-world-"glass-and-organics-make-a-good-team"/
Sustaindy events	http://www.gpi.org/recycle-glass-week/gallery/indiana/
Recycling Facts	http://www.pacebutler.com/blog/recycling-facts/
Single stream programs	http://www.container-recycling.org/assets/pdfs/reports/2009-SingleStream.pdf
Treehugger	http://www.treehugger.com/files/2009/05/calling-all-americans-we-need-to-recycle-more-glass.php
The Daily Green	http://www.thedailygreen.com/green-homes/latest/recycle-glass-47112004
Packworld dot com	http://www.packworld.com/news-26975
Dr. Vino	http://www.drvino.com/2009/07/30/wine-bottle-recycling-is-low-but-some-bottles-getting-lighter/
AMERICAN ASSOCIATION OF WINE ECONOMISTS	http://www.wine-economics.org/workingpapers/AAWE_WP09.pdf
Sustainability Times	http://www.tricorbraun.com/news-and-events/sustainability-times-newsletter/boosting-recycling-rates-bioplastics-and-ghgs/
A report on FMCG World Resources Institute	http://www.wri.org/publication/rattling-supply-chains http://pdf.wri.org/rattling_supply_chains_technical_document.pdf
Global Alerts	http://globalalerts.com/2009/09/23/earth911-com-receives-environmental-recognition-for-creating-recycling-awareness/
Japan Recycling	http://www.uwstout.edu/rs/2007/Recycling.pdf
The undergrad student compares Japanese and US recycling	http://www.cleanup.org.au/PDF/au/cua_glass_recycling_factsheet_final.pdf
Fact Sheet on glass recycling	http://www.cokecce.com/crs-reports/2009/s_index.html
Coca Cola reports focused on recycling	http://www.cokecce.com/crs-reports/2009/s_index.html
Article addressing efforts to avoid burning in landfills	http://www.no-burn.org/article.php?id=569
Article shows the extent of recycling done in NYC	http://www.nyc.gov/html/nycwasteless/downloads/pdf/wastecharreports/wcsfinal/highlights/wcs_05_rh_waste.pdf
Information about the impact of bottle bills	http://www.bottlebill.org/about.htm
Videos aimed at children	http://206.246.185.58/microsite/vid2.html
Resources provided by the glass packaging institute	http://gpi.org/glassresources/education/
Glass recycling wiki	http://en.wikipedia.org/wiki/Glass_recycling
Green Mountain Glass, LLC	http://www.greenmountainglass.com/pages/GlassFacts.html
INFORM	http://www.informinc.org/pages/research/waste-prevention/fact-sheets/case-reopened-reassessing-refillable-bottles-executive-summary.html
Climate Success	http://www.climatesuccess.org/case-studies/glass-maker-clear-about-energy-benefits/

Life cycle Analysis	http://www.britglass.org.uk/Files/LocalAuthorities/BGEnviroReport.pdf
Wine Business dot com	http://www.winebusiness.com/wbm/?go=getArticle&dataId=67379
Ask Leo and Lucy	http://www.guardian.co.uk/environment/2007/jan/14/ethicalliving.lifeandhealth
The Moseley Forum	http://www.moseleyforum.org.uk/?q=node/220
Telegraph newspaper	www.telegraph.co.uk/earth/main.jhtml?xml=/earth/2008/05/31/earecyc131.xm...
Further information about recycling glass	www.wasteonline.org.uk www.recycle-more.co.uk