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BA 339-001
Case Study #2

Scientific Glass Case Study Questions

1. What are the problems facing SG in January 2010?

Scientific Glass, founded in 1992 in Waltham, Massachusetts, has experienced significant growth in recent years and as such has increased their inventory management systems. SG was able to spur growth by bringing on their own dedicated sales team to educate potential buyers of SG's innovative new product lines, a tactic which has proven to be very successful in generating new sales. SG has also sought to beat the industry average (92%) for customer order fill rate (OFR) with their own goal of 99%. SG's strategy to reach this goal in the past has been to have the sales team coordinate with the warehouse managers, often relying on the sales team to perform or instigate inventory counts prior to large orders to ensure that the order could be filled.

There are two primary problems related to the new 99% OFR Goal:

1. The dedicated sales team has grown accustomed to exerting a large share of control on the inventory holding system, effectively removing the decoupling point between production and demand, and replacing it with the sales force's more arbitrary decision making.

2. Warehouse managers are keeping a higher inventory stock than is necessary to meet the 99% OFR. This results in significantly more inventory than SG needs to be holding, which drives up inventory holding costs.

3. How much external funding will have to be raised in 2010 to finance operations?

Table 1a: Excerpt from Scientific Glass' Income Statement (Exhibit 1)

Income Statement Accounts	2008	2009	2010 (Projected)
Net sales	65.0	86.3	103.61
Net earnings	4.5	6.5	7.5

- As **Table 1a** shows, in 2009 SG sold a total of 119,855 orders, totaling $86.34 million. Of that $86.3 million, $6.45 million, or roughly 7% was counted as net earnings.

- With an expected growth of 20% factored in, 2010 sales are expected at 143,826 total orders at $103.61 million. Assuming that net earnings can be estimated at 7% of the forecasted total sales, then net earnings will be $7.49 million for 2010. The 2010 net earnings will then be added to the Owners Equity account on the balance sheet (see **Table 1b** below) which brings the projected 2010 total capitalization to $72.4 million.

Table 1b: Excerpt from Scientific Glass' Balance Sheet			(Exhibit 1)
Balance Sheet Accounts	**2008**	**2009**	**2010 (Projected)**
Long term debt	17.2	21.7	21.7 + 3.9 = 25.6
Owners equity	24.5	31.0	31.0 + 7.4 = 38.4
Total capitalization	41.7	52.7	64.0
Total debt / total capital	0.48	0.47	0.40

- SG has plans to expand further into the European and Asia-pacific markets by adding one distributor to each, while simultaneously breaking into the Latin American market with one distributor. Each of these new distributors will cost $750 thousand of inventory in 2010 to begin selling in 2011. This adds up to $2.25 million to expand in these markets.

- To handle this expanding growth, manufacturing operations have outlined a need for an additional $10 million needed in 2010 to replace worn equipment and to increase capacity to meet future growth forecasts. This brings the total expansion cost up to $12.25 million.

This means SG will have total costs of $12.25 million to expand its sales and operations. If SG wants to meet its total debt to capital rate of 40%, they will need to raise no more than $3.9 million as short or long-term debt. This means that SG will need to invest $8.35 million of its own capital and reduce expenditures elsewhere.

4. How do SG's problems illustrate the relationship between the number of warehouses and inventory levels?

This is a fairly common problem for a business to have, especially a fast-growing firm like SG. APICS Magazine published an article by David Turbide in its September/October issue which outlined a very similar situation, only in his article the company was just finishing up a new highly automated warehouse while simultaneously planning a new lean manufacturing initiative that could greatly reduce the amount of inventory needed on hand.

In this article, Turbide narrows down the problem to the management not asking the right questions:

> When inventory levels rose to the point where existing warehousing and material-handling capabilities were becoming inadequate, executives asked, "What should we do to be able to handle this increased inventory?" What they should have asked was, "What can we do to prevent inventory growth or perhaps even reduce inventory so we don't need another warehouse.

The parallels between Turbide's situation and that of Scientific Glass are not exact, but they are close and the underlying point is the same: management at Scientific Glass were not asking the right questions. They were focused purely on sales, and did not adequately count the cost of increasing inventory to meet their sales goals, or put in a plan to manage inventory sustainably in such a way that they could still meet their sales goals. This has resulted in an unbalanced inventory system that is being run by the sales team and forcing the warehouse management to take contingency measures of holding excess stock to meet the service level goals of 99%.

The policy revisions found on page 7 of the case study enforce stricter inventory tracking procedures and eliminate the practice of allowing salespeople to maintain trunk stock. This is not a bad start, the sales team only has a clear picture of the demand side of the business, and as such they should not oversee the inventory management system.

But a smarter inventory counting system can be put in place that could significantly improve inventory counts while optimizing warehousing operations over a period: SG should consider incorporating Probability-based Cycle Counting into its inventory management system. This system will help SG to reduce the human errors that have been plaguing their system to date.

Writing for APICS Magazine, David Ross outlines the five major steps of using such a system:

1. **Assess current inventory integrity and set target accuracy levels.** In this stage, the inventory managers would identify their inventory control elements including stocking location, tracking systems, receiving procedures and transaction management. From there, a realistic target level is set along with how many items to count per day, how often those items will be recounted, and what procedures need to be followed as the count is underway.
2. **Perform the Cycle Count** as outlined in the procedures set in the previous

step.

3. **Track Variance Causes.** The cycle count results are recorded and submitted to an inventory-variance tracking team which will compile the results and look for patterns that will help them to root out underlying causes of variance and which items are most susceptible to it.
4. **Continuously Improve Accuracy.** The warehouse management and inventory tracking team will take steps to improve accuracy based on root causes identified while continuing the previous steps of the cycle.
5. **Compare Current and Target Accuracy Levels.** As inventory tracking improves and variances are eliminated, then new target levels are set.

The article goes on to explain the particulars of using a probability based system as opposed to an "imperial" based system, which is more or less how SG had been doing it up until this point. The 99% order fill rate might be too high and unrealistic of a goal, thus putting immense pressure on the warehouse managers to keep added stock. A more realistic, continuously improving goals can be set using this cycling method. While this system will help with the inventory tracking system, Scientific Glass should also consider reducing that amount of inventory that it holds. To accomplish that, we'll consider the other options:

5. **What alternatives are available for dealing with the inventory problems? How would you evaluate the alternatives?**

There are three primary alternatives identified in this case study for handling the inventory problems, which will be evaluated using the following criteria:

Inventory Holding Costs

Transportation Costs

- **Maintain the current warehousing system, but implement Gregory and Hayes' warehousing policy revisions.**

This option would mean retaining the current warehousing system with the eight regional sites. The issue with this option is that each additional warehouse has its associated inventory holding costs, which increases with safety stock and issues with lost or damaged goods.

- **Centralized Warehousing**

Ava could propose that Warehousing be reduced from eight regional warehouses down to only one or a few. Winged Fleet has provided rates for customer deliveries based on splitting the North American market into East, West and Central regions.

- **Outsourced Warehousing**

A competitor of Winged Fleet, called Global Logistics, has offered to take over the warehousing function entirely and will give discounted rates. The caveat being that SG would need to ship all goods from the manufacturing facility in Waltham, Mass. to Atlanta for distribution.

- **Analysis of Options**

Inventory Holding Costs

As the Tables 2a and 2b below show, the inventory holding costs are significantly lower using a single centralized warehouse. The data provided in the case study in Exhibit 3 (page 10) was analyzed using formulas for the Fixed-Order Quantity Models from the OSCM textbook (pages 364-367). Reducing to one warehouse, in conjunction with better inventory tracking practices as outlined above will reduce total inventory, but this analysis suggests that there may be a greater advantage to outsourcing the warehousing function entirely.

Table 2: Inventory Levels	**Total Inventory Costs**			
(assuming 20% increased sales)	**8 Warehouses**	**2 Warehouses**	**1 Warehouse**	**Outsourced**
Average bi-weekly demand (2009)	285	1,366	2,733	-
Stand. Dev. bi-weekly demand (2009)	121	259	462	-
Average bi-weekly demand (2010)	689	2,757	5,513	-
Stand. Dev. bi-weekly demand (2010)	292	522	932	-
Economic Order Quantity	166	296	529	-
Reorder Point ($R = dL + z\sigma$)	196	936	2,416	-
Finished Goods Incoming (2010)	$7,229,460.67	$7,229,460.67	$7,229,460.67	-
Total Ordering Cost	$113,160.93	$63,370.12	$35,487.27	-
Total Carrying Cost	$10,410.47	$18,590.13	$33,196.67	-
Annual Warehouse Cost	$7,353,032.07	$7,311,420.92	$7,298,144.60	$0.00

Transportation Costs

Tables 3a combines data from Exhibit 5 with forecasted sales revenue for 2010. show the price differences associated with transportation to the different warehouses. Table 3b then takes that data as appropriated per product category to calculate the associated transportation costs.

The current system with the eight regional warehouses is the cheapest option in terms of transportation costs at $1.38 million because this model effectively eliminates increased shipping costs across different regions. The two-warehouse system that SG used before expanding to eight costs $1.5 million, and a one warehouse system costs $1.7 million.

The most expensive option in terms of transportation costs is outsourcing, which, at $3.67 million is more than twice as much as what SG would pay for the single warehouse option.

Table 3a: Sales Revenue by Product Type

Product category	Forecast pounds shipped in 2010	2010 Average Shipments (at 9.8 lbs)	2010 Quantity (cases) of Sales	2010 Sales Revenue
Containers (bottles, flasks)	$ 696,300	$ 71,051	$ 232,100	$ 44,256,828
Measuring devices (beakers, pipettes, cylinders)	$ 192,450	$ 19,638	$ 256,600	$ 13,825,608
Fittings (stoppers, adapters)	$ 49,725	$ 5,074	$ 26,520	$ 5,839,704
Funnels	$ 34,688	$ 3,540	$ 18,500	$ 2,803,860
Handlers (stirrers, forceps, trays)	$ 97,425	$ 9,941	$ 103,920	$ 12,241,776
Tubes	$ 331,500	$ 33,827	$ 265,200	$ 24,133,200
Other	$ 2,700	$ 276	$ 21,600	$ 505,656
Total	$ 1,404,788	$ 143,346	$ 924,440	$ 103,606,632

Table 3b: Total Shipment Costs

Product category	8 Warehouses	2 Warehouses	1 Warehouse	Outsourced
Containers (bottles, flasks)	$ 686,353	$ 745,562	$ 863,980	$ 1,817,663
Measuring devices (beakers, pipettes, cylinders)	$ 189,701	$ 206,066	$ 238,795	$ 502,383
Fittings (stoppers, adapters)	$ 49,015	$ 53,243	$ 61,700	$ 129,805
Funnels	$ 34,192	$ 37,142	$ 43,041	$ 90,550
Handlers (stirrers, forceps, trays)	$ 96,033	$ 104,318	$ 120,887	$ 254,324
Tubes	$ 326,764	$ 354,953.1	$ 411,331	$ 865,367
Other	$ 2,661	$ 2,891	$ 3,350	$ 7,048
Total	$ 1,384,719	$ 1,504,174	$ 1,743,083	$ 3,667,140

6. What actions should Ava Beane propose to Eric Gregory and Melissa Hayes?

The combined analyses of the inventory holding costs and transportation costs comes out to this:

8 Warehouses	2 Warehouses	1 Warehouse	Outsourced
\$7,353,032 + \$ 1,384,719	\$7,311,421 + \$ 1,504,174	\$7,298,145 + \$ 1,743,083	\$0 + \$ 3,667,140
\$8,737,751	\$8,815,595	\$9,041,228	\$3,667,140

My conclusion is that Scientific Glass should outsource their warehousing system to Global Logistics. In doing so, they will potentially be able to save more than \$5 million. The money saved can then be used to wholly or partially finance SG's expansion into foreign markets as discussed in part one.

Additional savings are possible through this option by capitalizing on Atlanta, Georgia's Job Tax Credit, which is worth between \$750 to \$4000 per job created, per year for five years. By sourcing its warehousing functions through Global Logistics' Atlanta facilities, Scientific Glass will be creating a substantial number of warehousing jobs which may qualify for this tax credit, further incentivizing this option.

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