STONE BREWING COMPANY:
A CASE STUDY IN OPERATIONS & SUPPLY CHAIN MANAGEMENT

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ABSTRACT

This paper presents the supply chain management of Stone Brewing Company and the critical issues that is facing in the process of beer production. The objective is to demonstrate the operational and distribution issues in a small company and address some of critical issues that occur in the process of managing the supply chain. The company is a micro brewery producing west-coast craft brews (that is, with a traditionally 'hoppy' flavor). The company handles all of its own operations such as buying raw materials, planning, coordinating, storage, handling, brewing beer, packaging, and distribution to meet customer needs. The company also distributes niche foreign brand beers.

BACKGROUND

Stone Brewing Co. is a privately held craft brewery headquartered in Escondido, California. It was founded in 1996 in San Marcos, California. In 2006, Stone relocated from San Marcos to a new, custom-designed facility in Escondido. The facility includes a 58,000 square feet brewery, a visitor center, and restaurant. Rated as one of the best brewers in the US and world, by the two largest beer enthusiast websites, RateBeer.com and BeerAdvocate.com; the company has distribution centers in 31 states is known for its Arrogant Bastard Ale.

The brewery's production site is also home to a restaurant, **Stone Brewing World Bistro & Gardens**, a 300+ seat restaurant which features interesting architecture, a large outdoor patio and 1-acre of gardens. The restaurant serves a rotating menu of food - concentrating on organic, free-range and local ingredients - and beers from Stone, local San Diego and regional California craft brewers, and other specialty breweries in the United States and abroad. The facility also houses a "Stone Company Store" where Stone merchandise can be purchased in addition to 2L and 1L Growlers which can be filled with Stone's 7 year-round beers and special releases. in June 2008, it became more eco-friendly by installing 1,561 solar panels on the roof of the brewery and nearly cutting their energy costs by half – these roof-mounted modules expected to offset more than 538,000 pounds of carbon emissions over its lifetime, which is equivalent to planting 204 acres of trees.

Products, Packaging and Pricing

Stone produces a collection of beers characteristic of west-coast craft brews; that is to say, most beers have a traditionally 'hoppy' flavor. Seven different types of beer are available throughout the year and five special types of beer depending on season. Stone beers are bottled in different size of Barrel kegs, Growlers, Case-box, 22 ounce bottles, 12oz six packs, and occasionally 3 liter bottles. The beers available in six-packs are the Stone Pale Ale, Stone IPA, Stone Levitation Ale, Oaked Arrogant Bastard Ale, and Stone Ruination IPA. Stone uses 22oz bottles to feature their "bigger character" beers and Stone Special Releases. The alcohol-by-volume content of Stone brews ranges from 4.4% to well over 11%.

Prices vary for each of these different types beers of beer as the cost of producing varies with ingredients. See Tables 2 and 3.

Competition and Market Environment

The Beer Production industry is faced with declining domestic demand, and is in a decline phase of its industry life cycle. While US consumers have been switching away from beer to trendier beverages such as spirits and wine, producers have been introducing new and differentiated products in an attempt to excite consumers and stimulate demand. Craft beers have benefited from the emerging preference of consumers for variety and unique products. Although there has been some decline in the numbers of specialty brewers in operation, the volume and value of sales from these craft breweries is still increasing.

The total U.S. craft brewing industry annual dollar volume is $6.3 billion. The craft brewing industry produced nearly 8.6 million barrels of craft beer in the U.S. in 2008. The fastest growing segment of craft brewing sector continues to be microbreweries. Growth of the craft brewing industry in 2008 was 5.8% by volume and 10.5% by dollar amount. The recent downturn in the US economy is expected to have mixed effects on the industry. It is expected that some of those consumers who switched between alcoholic beverages will return to beer, as a relatively lower priced product. At the same time, producers will find it increasingly difficult to get consumers to trade up to the higher priced, niche products.

Overall, real prices are expected to decline in 2009, but industry volumes will grow moderately at an estimated 1.8% (compared to an average of 0.3% in previous years). Over the current period, craft breweries have continued to impact on the industry, competing on the basis quality and uniqueness. According to Brewers Association, there were 1,501 craft breweries including 65 regional craft breweries, 446 microbreweries and 990 brewpubs in the U.S. in 2008.

The main competitors are:

- Anchor Brewing
- Boston Beer
- Pyramid Breweries
- Alaskan Brewing Company
- Breckenridge Brewery
- New Belgium Brewing
- Pabst
- Weyerbacher Brewing

Degree of Governmental regulation

The industry is a minefield of differing legislation for brewpubs, microbreweries, excise, packaging and franchising. Regulations vary from state to state and are usually more stringent throughout Eastern states than in the West. Beer distribution follows “open states” regulation across the entire United States. In open states, brewers are allowed to sell beer and ale directly to independent distributors. Bureau of Alcohol, Tobacco Firearms and Explosives (ATF) is a law enforcement agency which enforces the Federal laws and regulations relating to alcohol e.g. regulating labeling, marking, packaging, branding and production of beer, ensuring to the best of its ability that an alcohol beverage label accurately reflects the contents in the container and checking alcohol beverages for compliance with Food and Drug Administration (FDA) decisions concerning food additives and colorings. Another agency known as, United States Alcohol and Tobacco Tax and Trade Bureau (TTB) publishes an industry circular to remind

brewers and importers of limitations to the use of flavors and non-beverage ingredients containing alcohol in the production of Flavored Malt Beverages (FMBs). In California, some of the regulations are:

- There is no microbrewery law but a microbrewery license fee of $244 annually.
- Microbreweries can distribute directly to customers and retailers.
- The maximum alcohol content permitted is 4% by weight for beer but no limits exist for ale.
- The excise tax rate is $0.20 per gallon.
- All bottles or cans containing ale, porter, brown, stout, or malt liquor of an alcoholic content of 4% or less by weight must have firmly affixed thereto in type of not less than one-sixteenth inch in height a notice specifically certifying that the alcoholic content of the beverages in the package is not greater than 4% by weight.
- There is no franchise law.

Inventory management

Grains and Hops are core ingredients used by Stone to produce craft beer. Cargill Inc and Great Western are the major suppliers of grains, and Cargill accounts for 90% of base grains supplied to Stone. Hops as the next main ingredient for making beer and are provided by suppliers such as Hopsteiner and Hopunion. Stone has an agreement with these hops suppliers to supply hops for a specific period of time. These ingredients (grains and hops) are first transported by train to Riverside and then shipped on a truck to the plant in Escondido. The cost of raw materials, various ingredients, packaging material and other such costs as transportation is roughly 45% of the company's annual sales revenue.

There is no independent warehouse or other storage facilities for the inventory. All the ingredients, together with packaging materials, work-in-process and finished goods, are stored in the production facility, which is basically divided into four areas: (1) producing area (used to produce beer and store work-in-process goods), (2) packaging materials storage area, (3) ingredients storage area, and (4) finished goods storage area.

The inventory of ingredients, packaging materials, and finished product is typically managed based on the production and order fulfillment schedule, rather than set minimums. One exception is that the plant has a week's worth of kegs (1,000 units) on hand at all times for packaging. Although management prefers to have an extended on-hand inventory of raw materials, but the lack of space and the high carrying costs has force Stone to keep a relatively low level of inventory of ingredients. To track inventory, the company has basically two systems in place: ***Great Plains software***, which provides for accounting and ***Eostar***, which allows the company to manage its order fulfillment.

For packaging materials, Stone has lead times of 10 weeks for ordering its bulk glass (bottles) and 3 weeks for labeled glass, and receives shipments daily. For grains and hops, the company is utilizing Fixed Order Quantity System (Q-System) to manage the inventory. That is, it places an order of a fixed quantity of 40,000 pounds of grains with a 2 weeks lead when the inventory declines to a predetermined "critical" level (reorder point) of 10,000 pounds, which is sufficient to meet production demand for the two-week period. For filtering needs, Stone keeps a 1 week lead on its supply. Team leaders in each area track the inventory level and place orders, and the production coordinator is ultimately responsible for reporting and reconciling inventory on a monthly basis.

Production Process

Revenue growth for Stone Brewing Co. has averaged 35% over the last three years, while production volume has also increased around 35% annually. In 2008, sales revenues were $36.9 million with a production volume of 83,000 Bbl. Currently VP of Sales makes sales forecasts, which determines the pro-

duction schedule. The demand for Stone's craft beer reveals seasonal fluctuation. There is generally a significant jump in demand starting in May and continuing through September and production schedules are set accordingly with the goal of minimizing on hand beer stored in tanks.

The brewing process in Stone Brewing Co. is completed in 7 steps; they are Mashing, Lautering, Boiling, Fermenting, Conditioning, Filtering, and Filling. The beer making process is as follow (the process is depicted in Figure 2):

- First, the grain is prepared by blending pale malt with specialty grains according to the particular recipe. The grist (milled grain) is then dispensed into a grist case until the right amount (measured by weight) is achieved.
- The grain is then run through the brew house, which consists of four vessels. This process takes about 5-6 hours. First, in the **mash vessel**, the grain is mixed with filtered hot water to activate sugar production by the enzymes in the grain.
- In the next tank, the **lauter vessel**, the grain is "lautered" *i.e.*, the sugar water ("**wort**") is drained from the mash.
- In the next vessel, the **boil kettle**, the wort is boiled and hops are added. Boiling effects three very important changes: 1) It sterilizes the brew, assuring that no microbes that might otherwise affect the beer's quality are present; 2) Cooking the wort changes its chemical structure, enhancing desirable aromas and flavors and diminishing undesirable ones; 3) Boiling extract the bitterness compounds from the hops and infuses them into the wort.
- In the last vessel, the hopped wort is spun in a **whirlpool** to allow solids to settle and be removed. Here, additional hops are added for aroma. All by-products (spent grain, protein solids, etc.) are then dispensed into a container and eventually transported away to be used as cattle feed. Stone brew house currently yields an average of 120 barrels per batch (roughly 4,000 gallons)

The Cellar

- The wort is transferred to a **fermenter** vessel in the cellar, where yeast is added to it. After the fermentation (*i.e.,* the conversion of sugars into primarily alcohol and CO2) is complete, the yeast is settled to the bottom of the vessel. Fermentation usually takes about four days.
- The beer may now be conditioned for a few days to a month, depending on the recipe. In the case of "dry-hopped" beer, for example, the beer is allowed to "sit" on additional hops for a few weeks.
- The beer is then filtered—Stone uses a cylindrical filter filled with a fine mineral powder to filter its beer—and stored in a bright tank (the large flat bottomed tanks in the brewery) where it awaits packaging.
- The beer is either sent to the bottling line or kegged.

The Kegging Line

- Kegs are loaded upside down onto the keg washer/filler where they are first emptied and rinsed of any residual beer.
- The keg is then pressurized with CO2 and sanitized on the inside with a hot caustic solution; it is then steam rinsed.
- After an external washing (the keg is rotated at high speed and sprayed), it is sanitized with a hot acid solution and steam rinsed.
- Finally, the keg is filled with beer, its opening is sanitized and the keg is loaded onto a pallet with other filled kegs. Stone currently fills an average of about 200 kegs a day.

The Bottling Line

- Cases of labeled, empty bottles are loaded onto the line where they are mechanically "uncased" and placed onto a conveyor. Meanwhile, the cases are conveyed to the casing machine where they await filled bottles.
- Bottles are then conveyed into the rinser cabinet where they are inverted and rinsed with an iodine based sanitizing agent.
- After rinsing, bottles are conveyed onto the filler, a "carousel" consisting of 72 sets of lifts and fill tubes. The hydraulic lift elevates each bottle, placing it around the fill tube. A rocker cam is activated and the bottle is filled with CO2 for sanitization and to prevent air from entering.
- Next, the rocker cam switches positions and now the bottle is filled with pressurized beer.
- The bottle is lowered by the lift and fed onto a revolving crowning machine with places crowns (caps) on each bottle.
- After crowning the bottles are rinsed and checked for proper fill levels.
- Bottles are then automatically dropped into the cases from which they were initially pulled.

Quality Control Process

The quality of beer is paramount to Stone and other measures such as growth and market share are considered secondary to its mission. Stone uses methods of statistical quality control as outlined by the ASBC manual (American Standards of Brewing Chemistry) while incorporating some methods used in six sigma methodology. Most of the production team members acquire the skill set necessary for such work through on the job training.
Stone has a quality control protocol in place during every step of the process at Brewing, Cellaring, and Packaging - from temperature to proper concentrations of sugar, yeast, dissolved oxygen to filtration quality and more. These are constantly monitored, analyzed and updated. Their HMI (human machine interface) is a software program called ***Braumat*** (by Siemens) and it has been customized to efficiently monitor and document all of the QC measures while simultaneously comparing them with the parameters of past batches.

Distribution Coverage

The company has its own distribution services and also works with other distributors to help move its own brand. It has distributors in 31 states (see Table 4). In the plant, there is a dedicated temperature controlled partitioned space called "Cold Box" where all Stone beer packaged in kegs, barrels, bottles, and other wholesale products are kept. As order comes in, the delivery is made from the products that are ready in Cold Box. In California, Stone itself is the distributor where it delivers the products to super markets such as Ralphs, Vons, Albertson's and Stater Bros. Stone also acts as "wholesaler" representing brands from Europe such as ***Paulaner*** (a German beer manufacturer) and other small brands twice a month and typically keeps a month's worth (to distribute to retail accounts) on hand at all times. Wholesaling other brands has cut the overhead costs for Stone for distributing its own branded products a great deal.

Current Challenges

Based on company's data, in 2008, the current annual effective capacity (231 production days) is 83,000 barrels of beer. However, the annual design capacity (365 production days) is 131,400 barrels. The de-

mand in 2010 is estimated to be 151,267 barrels, which will exceed the design capacity of 131,400 barrels. Hence, the company faces production capacity issue as the demand is increasing at the rate of 35% annually.

Possible Recommendations

The following approaches could be used to meet demand and price increases for the material:

- Move the Raw material, finished goods and wholesale goods inventory to a new location near to the current facility - this would free up space for added production equipments.
- Use night shifts to increase the daily batch production. This approach can used to meet the demand for the next three years. However, in future, the company has to work on increasing the plant size by relocating to new place or separating the production facility as a separate unit.
- Currently, Stone tries out new recipe in a small area within the Hops storage place. If the company succeeds in moving the inventory of goods to a new location, a small dedicated R&D centre can be created for trying out new recipes. This would provide the company with a distinctive competitive edge from its competitors.
- Because of shortage of grains and hops in the current marketplace, prices for these ingredients have increased substantially. These and anticipated escalating costs will be having adverse affect on the cost of producing beer and reduce the profit margins. To remedy this problem, the company should look to overseas suppliers from Europe and Asia, who can offer lower prices or are willing to sign future contracts to lock in the current prices.