

Beer in the Classroom: A Case Study of Location and Distribution Decisions

Murat Köksalan

*Industrial Engineering Department
Middle East Technical University*

F. Sibel Salman

*College Of Engineering
Koç University*

Case Study of Location, Distribution, and Capacity Expansion Decisions at Anadolu Efes

1. Introduction

Anadolu Efes has dominated the Turkish beer market in the last two decades as a result of careful planning and successful strategies in distribution, pricing and marketing. Consequently, Efes has become synonymous with beer in Turkey and has reached an impressive 78% market share in 2000 (Exhibit 1). The company has also extended its business line by buying the right to bottle Coca-Cola in Turkey in 1998, and has been transforming into a multinational identity by building up international brewing operations mostly in Eastern Europe, Russia and Central Asia. The two main challenges faced by the company in the new millennium are to succeed in its business diversification efforts and to maintain its market position in its core Turkish brewing business.

Emre Yaman, who was hired as the Chief Executive Officer of Efes nearly one year ago, has a couple of major issues in mind as he shapes the business plan of the company for the years to come. In terms of domestic operations, an immediate issue is that the anticipated increase in beer demand will surpass Efes' total production capacity in a couple of years. A capacity expansion plan has to be prepared carefully to address this problem. Such a plan will also prove useful to deter any foreign entries to the attractive Turkish beer market. In fact, increasing competition is the other major issue in Emre Yaman's agenda. He has already seen the first signs of pressure when Efes' main competitor Turk Tuborg was acquired by the Danish Carlsberg Breweries in September 2001 and subsequently launched the "Carlsberg" branded beer against Efes' own "Miller Genuine Draft". Although Emre knows that Efes' long-time brand "Efes Pilsen" has a very loyal customer base, he believes that the strength of Efes' production-distribution network will play a key role in the competition.

Emre Yaman mentions some of his concerns to Ali Yurtoglu, the Vice President for Logistics and Defne Kutay, the Vice President for Marketing over a game of golf by the Bosphorus.

Emre Yaman (CEO): "The latest figures in the annual activity report show that our distribution costs constitute about 25% of our cost of goods sold. I wonder if we can do better."

Ali Yurtoglu (Vice President for Logistics): "I have also been looking into this recently and assigned our new employee Selin Baydar to analyze our distribution system. She thinks that there is room for cost reduction if we optimize our malt and beer shipment plan. "

Defne Kutay (Vice President for Marketing): "If we aim to lower costs, we may have to compromise from the efficiency of our supply chain. Our breweries may be reluctant to damage the loyalties that they have worked hard to develop. Ankara brewery has been supplying all the beer for the distributor in Bursa and Istanbul brewery has been supplying all the demand of the distributor in Antalya for a long time. Both of these breweries and distributors have built strong relationships and would prefer to keep the existing relationships."

Emre: "Why don't we first look into the potential savings and decide later whether it is worth making any changes."

Ali: "Actually, we already have most of the data to make this analysis. We have estimates of the costs of malt and beer shipments between various locations. We know all malt plant and brewery capacities and can obtain projected beer demand figures for the next year."

Emre: "That sounds great. Once you obtain the results of the analysis, we can meet and decide on how to proceed."

2. Company Background

Efes Beverage Group is the largest business unit of Anadolu Holding, which was founded in 1969 in Istanbul and named after the Turkish peninsula Anatolia. The two founding families who still hold 55% of the

shares control the holding. The remaining 45% of the shares are traded on the Istanbul Stock Exchange. In addition to the beverage sector, Anadolu has diversified interests in the automotive, office supplies, packaging and financial sectors and has joint ventures with international companies such as Honda, Isuzu, Itochu and Faber-Castell.

The principal activities of Efes Beverage Group are in the production and distribution of malt, beer and plastic crates. Beer sales accounted for 96% of 2000 gross revenues; the remaining 4% came from malt, plastics and other. Efes Beverage Group operates nine breweries and four malteries in five countries and also conducts Coca-Cola operations in five CIS countries. Efes Beverage Group, together with its parent, Anadolu Holding, is the largest local shareholder in the Turkish Coca-Cola franchise, controlling 40% of the shares. In June 2000, the production companies of Efes Beverage Group merged into a single entity: *Anadolu Efes Brewery and Malt Industry Corporation*. According to Finansinvest Research Group of Istanbul, the value of Anadolu Efes was \$1.143 million in November 2001. As of May 2002, the company was the eighth largest Turkish company by market capitalization.

Efes has an annual beer production capacity of around 1.4 billion liters. The company owns five breweries and two malt plants in Turkey. The domestic plants have an annual total production capacity of 910 million liters of beer and 97,500 tons of malt. The marketing and distribution company of the group is responsible for the direct distribution of *Efes Pilsen*, *Efes Light*, *Efes Dark*, *Efes Extra*, *Everest*, *Miller* and *Beck's* products in six main regions of Turkey, and works through distributors in 300 districts. In 2000, Efes' share in the Turkish beer market has reached a record high of 78%. Turk Tuborg is its only significant competitor (Exhibit 2). The third player in the market is the state monopoly, Tekel with nearly 1% share. Imported high premium brands do not even constitute 1% of the market.

Efes sells its products in more than 30 countries worldwide (Exhibit 3). While a few shipping containers make their way to the U.S. every year, Efes has seen outstanding consumer response in Russia, Eastern Europe, the Caucasus and Central Asia. The company has been active in these markets via its subsidiary Efes Breweries International after the construction of breweries in the Romanian city of Ploiesti and Moscow,

and the acquisition of breweries in Kazakhstan and Ukraine in late 1990s. The sales volume of *Efes Breweries International* almost tripled in 2000, during which the Moscow brewery became fully operational, and has increased its sales volume to 23% of total beer sales of the Efes Beverage Group.

3. Turkish Beer Market

Turkish beer market has a size of 730 million liters and around \$294 million sales value, according to a 2001 report by Finansinvest Research Group⁽³⁾. Finansinvest pointed out the potential for growth in the market considering that an annual population growth of 1.2% is expected and around 50% of the current population of 65.7 million people is below the age of 25⁽⁴⁾.

Turkey increased its beer intake by more than 50% to a level of 16.8 liters per person from 1995 to 2000. Despite this exceptional growth, the per capita consumption is below the global average of 22.7 liters⁽⁵⁾. Turkey ranks as the tenth largest beer-consuming nation in Europe despite its relatively low per capita consumption. The nation of 65.7 million people imbibed more than 1.1 billion liters of beer in 2000, about one-eighth of what leading Germany's 82.8 million residents consumed.

Beer consumption is closely related to cultural and demographic factors. Surveys indicate that around 48% of the adult population in Turkey consumes alcoholic beverages, and around 42% percent of those who do not drink state that their religious beliefs are the main reason for abstaining. Although being a predominantly Muslim nation, Turkey has been a secular state since the establishment of the Republic in 1923 and the Turkish government imposes no restrictions on alcohol consumption. However, the Turkish government banned broadcast advertising for all alcohol products in 1995, forcing Efes to rethink its advertising strategy. Since then, Efes has particularly increased its sponsorship of sporting events, concerts and its own successful professional basketball team.

4. Trends in the Global Brewing Industry

World beer consumption was expected to be around 126 billion liters in 2000. USA and China account for 36% of the global beer market, while emerging markets

make up a significant 45%. Consumption in emerging markets has been growing as drinking cultures of the populations change. Major US and Europe based brewers have been focusing on the Eastern Europe, China and the CIS countries for growth opportunities. In particular, Carlsberg has become more active in Eastern European markets and Turkey recently. Heineken has significant stakes in a number of Eastern European brewers but not with the Turkish companies.

4.1. Part I: Improving the Current Production and Distribution System

Beer is produced by malting barley, brewing, distilling and bottling. The beer production process, described in Exhibit 4, has been going on in Anatolia for thousands of years (Exhibit 5), and has remained essentially unchanged to our day; now taking place at the modern malt plants and breweries. Efes has two malt plants, both located close to main barley regions in Konya and Afyon (Figure 1). Malt produced at these plants, or imported at the Izmir harbor is transported to Efes' breweries in Istanbul and Ankara. Efes ships beer produced at the breweries to its main distribution centers in Istanbul, Izmir, Antalya, Bursa, Kayseri and to the Izmir harbor for export.

The estimates on the transportation costs between the malt plants and the breweries; and between the breweries and the distribution centers are given in Exhibit 6. Exhibit 7 contains the beer demand forecast at the distribution centers for the next three years and Exhibit 8 shows the current malt and beer production capacities as well as the malt yield. Exhibit 9 summarizes the current distribution plan prepared for the next year.

Having solved a linear programming model to optimize the production and distribution system, Selin Baydar explains the results to her supervisor Ali Yurtoglu. "I used the model to figure out how many tons of malt to ship from each malt plant to each brewery and how much beer to ship from each brewery to each distributor. I also made sure that none of the capacities of the malt plants or breweries is exceeded, and all the beer demand of the distributors is satisfied. The shipment plan that minimizes total costs is quite different from the current plan but we can save around 10% in

(3) <http://www.finansinvest.com/>

(4) Beer is mostly preferred by the younger generation due to its price and availability.

(5) According to the report titled "Recent Developments in Turkey's Beer Market" by John G. Rodwan, dated 3/15/2002.

our transportation costs." Ali is content with the results. "Great, for such sizeable savings we may convince Defne and Emre that it is worth the effort for changing a few of the established relations in the distribution network."

Selin Baydar is excited about the upcoming meeting with Emre Yaman, Defne Kutay, and Ali Yurtoglu, where she presents the results of her analysis of the distribution system.

Emre: "I'm impressed by Selin's findings on the distribution plan, but to what extent can we implement them?"

Defne: "We will need to work proactively with the distributors. We need to explain them how all parties in the supply chain will eventually benefit from pulling the costs down. We should also go in the direction of streamlining the information flow electronically to enable stronger supply chain collaboration. When we first begin to implement the changes, we may launch a promotion campaign to keep the distributors happy."

Emre: "Let us aim to implement the optimal distribution plan, and resolve the initial problems within three months."



Figure 1: Picture Location of Efes' Facilities.

4.2. Part II: Capacity Expansion Decisions

Emre Yaman has a bigger project in his agenda: opening new breweries.

Emre: "At this point we need to focus on keeping our market share in response to demand growth. Our demand forecasts indicate we will need more brewing capacity soon. We cannot expand the current breweries any more and will have to open a new brewery after

the next year. The Manufacturing Department has done some research on this. The new brewery will use the latest technology and will have an initial capacity of 70 million liters per year. We can expand the capacity at the new brewery to 120 million liters per year any time we like quite inexpensively. We will most likely borrow money for all the investments. I expect this to cost us around 10% in interest annually."

Selin: "Do you have possible locations in mind? The location of the new brewery may make a huge difference in terms of our transportation costs."

Emre: "You're right. Our technical staff looked at several factors to determine possible locations. The primary factor was to have a good quality water source. They have also considered beer demand concentrations and proximity to malt plants. They suggested Izmir, Sakarya and Adana, and estimated the costs of building and expanding plants in each of these locations (Exhibit 10)."

Selin: "Great, we can use these cost figures to build a mathematical model and find the decisions that yield the minimum cost. We may then do some what-if analysis to see if the results are sensitive to the cost estimates."

Emre: "You managed to optimize the distribution plan very quickly. Would it be possible to find a minimum-cost solution to this problem as well?"

Selin: "In this case we have a fundamentally different aspect that makes the problem more complex. We need to decide whether or not to open a new brewery in each of the locations and whether or not to expand each. It will be interesting to work on this."

Ali: "We may decide also when to open the new brewery. I understand that we cannot delay opening it more than two years if we don't want to lose our market share, but is it an option to open the brewery next year? Similarly, we can consider early expansion."

Defne: "Why would we want to open it a year in advance of our need? We would be tying up millions of dollars."

Selin: "By opening a new brewery, we may start saving in transportation costs."

Emre: "Then, the question is whether the savings in transportation costs offset our cost of opening the brewery early. As much as I would like to continue this discussion, I need to go prepare for my TV interview. I will be expecting the results of your analysis."

As Selin and Ali walk back to the Logistics Department, they start planning their next assignment. When Selin points out that the fixed costs of opening and expanding the breweries are one-time costs and the benefits of these are realized over the years in reduced transportation costs, Ali responds "We can add up the present value of all costs over the next 20 years in the objective function. As the future costs are discounted, any benefits from reduced transportation costs beyond 20 years will be insignificant." Selin suggests to optimize the shipment and new brewery location/expansion decisions for the next three years, and to use the third year distribution plan to estimate the future shipment costs.

Ali: "I don't think we could go much farther than 3 years for detailed planning anyway. There would be too much uncertainty in the cost and demand estimates."

Selin: "Let's keep in mind our assumptions and the implications of under/over-estimating the costs. I guess we will also assume that we will carry no inventory at the end of each year. I expect to refine these ideas when we actually start working on the model."

Selin continues to describe the model to Ali while the two sip their afternoon tea at the Logistics Department: "The decision variables will comprise the 0-1 variables and the transportation variables. For each location and year combination, there will be a 0-1 variable showing whether a brewery is opened, and another 0-1 variable showing whether a brewery is expanded. We also need malt and beer transportation variables just like in the previous model, but this time we will define one set of such variables for each year. The model will have the regular supply-demand restrictions between the malt plants, breweries and the distributors. The only trick here is in defining the capacity of the new brewery at the potential sites. We should make sure that the model incurs the fixed cost in the objective function if it wants to use the capacity."

Ali: "This will teach the model that there is no free lunch!"

Selin: "We should also write constraints to account for the relation between a new brewery and its expansion. We need to make sure that the model solution will not expand a brewery that has not been opened yet."

Ali: "Without those constraints, I would imagine the model would keep expanding non-existing breweries as the expansion capacities are much cheaper. There really seems to be a lot of work but you also seem to have everything under control. Let's get to work!"

Note: The information regarding the company background, Turkish beer market, and trends in global brewing industry are accurate as collected and cited from various sources in the Internet. The problem is a hypothetical one but is similar to problems Efes has been facing. Efes' real distribution system has been simplified for the purpose of keeping the model size manageable. All the characters and positions mentioned throughout the case are fictional.

4.3. Exhibits

Exhibit 4: Beer Production Process

Beer is the product of fermentation of the carbohydrates in cereals, such as maize, rice, millet, oats, rye, wheat and most commonly barley. The main ingredients of beer are malt, water and hops. Malt, the processed grain that has begun germination by being soaked in water, provides beer its body and color. Hops is used in small amounts to prevent the brew from going sour, but also brings a characteristic bitter flavor and a pleasant aroma. Water constitutes as much as 95 percent of the ingredients used in the brewing process. The mineral content in water influences the quality and the flavor of the beer.

Brewing of beer is essentially a four-stage process. The first stage requires mixing malt, sugar, hops and water into wort by means of a "cooking" procedure that involves mashing and boiling in large copper kettles. In the second stage of brewing, wort is chilled and transferred into a fermentation tank. Yeast is added in the third stage, through which fermentation takes place in three to ten days. In the final stage, flat beer is stored for slow fermentation and aging for a few weeks to several months, depending on the type of beer being produced, after which it is carbonated and bottled.

Exhibit 5: A brief history of beer production in ancient times. Source: Efes Pilsener⁽⁶⁾

How long have we been drinking beer?

Mankind has been brewing and drinking beer for thousands of years. The earliest recorded beer recipe was found in clay tablets written 7,000 years ago. Beer originated in Mesopotamia and then found its way to Anatolia and the Nile river valley. Four thousand years ago in Anatolia, Hittites, who had founded one of the biggest and most sophisticated civilizations of its age, were drinking beer in daily life as well as in sacred rituals. Ancient Egyptians used beer as a remedy for various maladies.

Various civilizations around Asia and Africa produced beer using different types of grain. After the eighth century A.D., hops became a part of the beer production process, enabling better preservation. In Medieval Europe, monasteries and abbeys were where most of the breweries were located. Monks had a near monopoly on beer production. In the dark ages when this old continent was in the throes of epidemics, drinking water was one of the main culprits of disease. Beer, on the other hand, was boiled and hence saved many lives as a disinfected and nourishing drink.

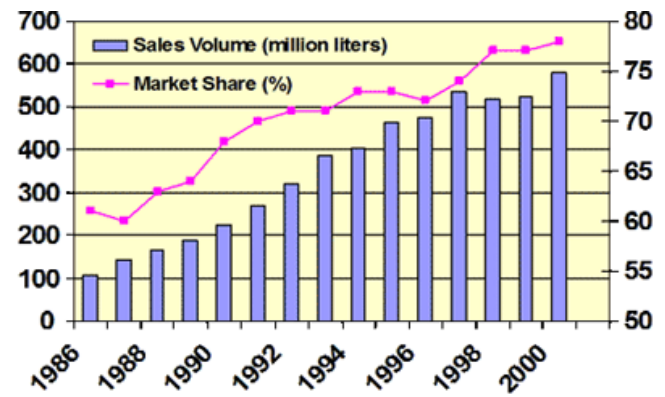


Exhibit 1: Efes' domestic beer sales volume over the years and the growth of its market share. Source: Anadolu Efes Annual Activity Report dated 2000.

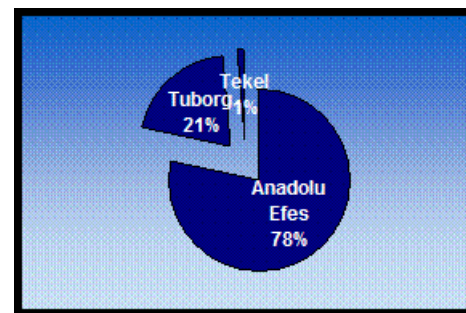


Exhibit 2: Share of major parties in the Turkish beer market (2000). Source: Finansinvest Research Report dated 2001.



Exhibit 3: Countries to which Efes exports beer. Source: Anadolu Group (<http://www.anadolugroup.com/>)

⁽⁶⁾ <http://www.efespilsener.com/>

TRANSPORTATION COSTS:**Cost of shipping malt from plant *i* to brewery *j* (Million \$ / 1000 tons)**

Malt Plants	Destinations				
	Existing Brewery Sites		Potential Brewery Sites		
	Istanbul	Ankara	Izmir	Sakarya	Adana
Afyon	0.026	0.017	0.020	0.019	0.032
Konya	0.037	0.017	0.031	0.030	0.022
Import(Izmir)	0.032	0.033	0.004	0.028	0.048

Cost of shipping beer from brewery *j* to distribution center *k* (Million \$ / Million liters)

		Distribution Centers					
	Breweries	Istanbul	Izmir	Antalya	Bursa	Kayseri	Export (Izmir)
Existing	Istanbul	0.000	0.040	0.052	0.017	0.055	0.042
	Ankara	0.032	0.041	0.039	0.027	0.023	0.043
Potential	Izmir	0.040	0.000	0.032	0.023	0.062	0.002
	Sakarya	0.011	0.034	0.041	0.011	0.045	0.036
	Adana	0.067	0.064	0.040	0.060	0.024	0.066

Exhibit 6: Malt and beer transportation costs.

DEMAND:**Annual demand at distribution centers (Million liters/year)**

Dist. Centers	Year 1	Year 2	Year 3
Istanbul	103	110	125
Izmir	74	80	90
Antalya	50	53	60
Bursa	60	75	85
Kayseri	102	110	125
Export (Izmir)	13	13	15
Total	402	441	500

Exhibit 7: Beer demand forecast at the distribution centers for the next three years.

CAPACITY:**Annual capacity of malt plants (1000 tons/year)**

Afyon	30
Konya	68
Import (Izmir)	20

Annual capacity of breweries (Million liters/year)

	Existing Breweries		
	Istanbul	Ankara	Izmir
	220	200	
	Potential Breweries		
	New	Expansion	
	Izmir	70	50
	Sakarya	70	50
	Adana	70	50

MALT YIELD:**Million liters of beer brewed from 1000 tons of malt**

Domestic	8.333
Import	9.091

Exhibit 8: The current malt and beer production capacities, and malt yield

Amount of malt shipped from plant <i>i</i> to brewery <i>j</i> in Year 1 (1000 tons)				
	Istanbul	Ankara	Total	Capacity
Afyon	0	24	24.00	30.00
Konya	2.42	0	2.42	68.00
Import	20	0	20.00	20.00
Total malt	22.42	24		
Total beer	202	200	(Million lt)	

Amount of beer shipped from brewery <i>j</i> to distribution center <i>k</i> in Year 1 (Million liters)								
	Istanbul	Izmir	Antalya	Bursa	Kayseri	Export (Izmir)	Total	Capacity
Istanbul	103	49	50	0	0	0	202	220
Ankara	0	25	0	60	102	13	200	200
Total	103	74	50	60	102	13		
Demands	103	74	50	60	102	13		

Exhibit 9: Current distribution plan for Year 1

FIXED COSTS: (Million \$)		
<i>Potential Brewery Sites</i>	Open	Expand
Izmir	75	30
Sakarya	70	27
Adana	68	25

Exhibit 10: Costs of opening and expanding breweries at the potential sites.