The Optimal Way to Increase Production Capacity in Ulaanbaatar Mayonnaise Factory of Mongolia

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ABSTRACT

There are many strategies and ways to increase production capacity. But it is very important to choose the optimal way. Inadequate capacity can lose customers and limit growth. Excess capacity can drain a company's resources and prevent investment in more lucrative tures. When to increase capacity and how much to increase it are critical decisions. So in this study we will intend to investigate the role of production capacity in operation management. Then we will define the optimal way to increasing production capacity of Ulaanbaatar mayonnaise factory in Mongolia. We used secondary data. In this study's informations about production capacity from the reference books, other research papers. And then information about the company's operation comes from Ulaanbaatar mayonnaise factory's annual production report, official website. Other useful information from the report of National Statistics Office of Mongolia and official website of Mongolian customs. Our main technique of analysis is Decision tree analysis. It is necessary to compare the financial benefits of ways to increasing production capacity and select the optimal way to increase production capacity in Ulaanbaatar mayonnaise factory of Mongolia. Also we used Microsoft Excel software to calculate the production capacities. Our expected result is how company can increase the market share by choosing the optimal way to increase production capacity also how the use production capacity as a competitive weapon and how they can produce product that exceed customer expectations by increasing capacity.

KEYWORDS: production capacity; capacity utilization rate; demand; bottleneck; decision tree analysis

A. INRODUCTION

In recent years, the number of SMEs is increasing and the sector plays an important role in the economy. In 2016, there were 141,502 entities registered in business register funds in Mongolia. Actually, only 72,182 enterprises are running business actively, of which 77.8% or 56,189 was Small and Medium Sized Enterprises. However, most of them do not meet market demands because of the low production capacity. Because of this or a sharp rebound in demand, increasing production capacity is an issue which most SMEs are faced with. Jigd Khuch LLC is one of the small and medium-sized enterprises of Mongolia, founded in 2005. The company is engaged in manufacturing and supply of mayonnaise, milk and dairy product and dairy farming. At present, there is only one mayonnaise factory in Mongolia. Jigd Khuch LLC's Ulaanbaatar mayonnaise factory is leading the Mongolian mayonnaise market for the last 3 years. But this factory faced with capacity problem. This report aims to examine the role of production capacity in operation management. Especially, intent to investigate: How the companies select the optimal way to increase production capacity? What is the benefit of increasing capacity by optimal way?

B. THEORY AND LITERATURE REVIEW

Production capacity is one of the important aspect of production system and it's defined as the maximum output that a manufacturing operation can produce with the available resources in a given period. The operations manager must provide the capacity to meet current and future demand. Inadequate capacity can lose customers and limit growth. Excess capacity can drain a company's resources and prevent investment in more lucrative tures. Capacity affects:

- ➢ Firm's ability to compete
- ➢ Operating cost
- ➢ Product mix
- ➢ Market share
- ➢ Customer responsiveness

Capacity measurements

Design capacity is the maximum theoretical output of a system in a given period under ideal conditions.

Utilization is simply the percent of design capacity actually achieved. The capacity utilization rate reveals how close a firm is to its design capacity.

$$\text{Capacity utilization rate} = \frac{Capacity\ used}{Design\ capacity}$$

When making capacity decisions, managers need to forecast demand and then they must calculate capacity utilization.

Determining capacity requirements

In determining capacity requirements, we must address the demands for individual product lines, individual plant capabilities and allocation of production throughout the plant network. Typically this is done according to the following steps:

1. Use forecasting techniques to forecast sales for individual products within each product line.
2. Calculate equipment and labor requirements to meet product line forecast.
3. Project labor and equipment availabilities over the planning horizon.

Increasing maximum capacity

Most processes involve multiple operations, and often their effective capacities are not identical.

True expansion of a process's capacity occurs only when bottleneck capacity is increased. A bottleneck is an operation that has the lowest capacity of any operation in the process and thus limits the system's output. In effect, the process can produce only as fast as the slowest operation.

The long-term capacity of bottleneck operations can be expanded in various ways.

➢ Investment can be made in new equipment and in brick-and-mortar facility expansions.
➢ The bottleneck's capacity also can be expanded by operating it more hours per week, such as going from a one-shift operation to multiple shifts, or going from five workdays per week to six or seven workdays per week.

Managers also might relieve the bottleneck by redesigning the process, either through process reengineering or process improvement.

Capacity strategies

Operations managers must examine three dimensions of capacity strategy before making capacity decisions: sizing capacity cushions, timing and expansion, and linking capacity and other operating decisions.

1. Sizing capacity cushions: Average utilization rates should not get too close to 100 percent. When they do, that usually is a signal to increase capacity or decrease order acceptance so as to avoid declining productivity. The capacity cushion is the amount of reserve capacity that a firm maintains to handle sudden increases in demand or temporary losses of production capacity; it measures the amount by which the average utilization falls below 100 percent. Capacity cushion=100%-Utilization rate%

2. Timing and sizing expansion: The second issue of capacity strategy is when to expand and by how much. There are two extreme strategies: the expansionist strategy which involves large, infrequent jumps in capacity, and the wait-and-see strategy, which involves smaller, more frequent jumps. The wait-and-see strategy lags behind demand, relying on short-term options such as use of overtime, temporary workers, subcontractors, stock-outs and postponement of preventive maintenance to meet any shortfalls.

3. Linking capacity and other decisions: Capacity decision should be closely linked to strategies and processes throughout the organization.

C. METHODOLOGY

A convenient way to lay out the steps of a capacity problem is through the use of decision trees. The tree format helps not only in understanding the problem but also in finding a solution. A decision tree is a schematic model of the sequence of steps in a problem and the conditions and consequences of each step.

Decision trees are composed of decision nodes with branches to and from them. By convention, squares represent decision points and circles represent change events. Branches from decision points show the choices available to the decision maker; branches from chance events show the probabilities for their occurrence.

In solving decision tree problems, we work from the end of the tree backward to the start of the tree. As we work back, we calculate the expected values at each step.

Once the calculation are made, we prune the tree by eliminating from each decision point all branches except for the one with the highest payoff. This process continues to the first decision problem, and the decision problem is thereby solved.
Data

Currently factory produce 1 flavor of mayo and 2 kind of package that pouch and plastic. And company producing following 3 kind of product.

Table1. Sales of Ulaanbaatar mayonnaise, kg

Year	2013	2014	2015	2016	2017	2018
I	274977	290227	288257	369323	411867	461867
II	170818	165148	174648	220531	250634	310634
III	216164	185705	189458	241400	232704	272704
IV	287290	271853	331329	383614	437371	487371
Total	949249	912933	983692	1214868	1332576	1532576

Product sales are increasing annually. In 2018 company sold 1532576kg mayonnaise.

Table2. Mayonnaise import by country, kg

Country	2015	2016	2017	2018
China	148715.9	108724.9	90184.1	85600
Germany	23715.5	15440.4	7467.2	8000
Korea	337712.2	207308.2	53203.7	60548
Poland				
Russia	1991732.9	1609626.1	2277045.2	2459055

Thailand				
Belgium				
France	6.4			
Britain	240			
Kyrgyzstan				
Malaysia	18562.6	29819.6	8492	9458
Singapore	23213.8			
Turkey				
Ukraine	4339.8			
USA	30.1	599.8		866
Japan	469			
Estonia	6268.2			
Philippines			6.4	
Total Import mayonnaise	2555006.4	1971519	2436398.6	2623527
Ulaanbaatar mayonnaise /Domestic production/	983692	1214868	1332576	1532576
Total sales of mayonnaise in Mongolian market	3538698.4	3186387	3768974.6	4156103
Market share	28	35	35	37

In 2018 2623527 kg mayonnaise was imported from China, Germany, Korea, Russia, Malaysia,

USA. 2018 domestic production accounted for 37 percent of the total market. It means Ulaanbaatar mayonnaise market share is 37 percent.
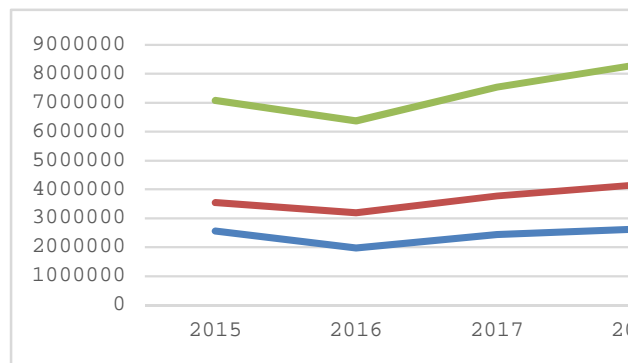

Figure 1. Mayonnaise sales growth

In figure 1 shows the last 4 years mayonnaise sales of Mongolian market. Blue line is import mayonnaise, red line is domestic, green line is total sale of mayonnaise. We can see all these three indicators are increasing. But percent of domestic production is higher than percent of imported product.

Current situation of Ulaanbaatar mayonnaise factory
We have to investigate the current situation of the factory in order to optimize future planning and decision. Ulaanbaatar mayonnaise factory is a semi-automatic factory. We made the capacity analysis using by the secondary data. Company's "5C" program working group collected the information about all equipment and process flow's capacity. In figure 2 river column shows the factory's all equipment and process flow. In the first column current capacity of all equipments. There are two bottleneck emulsion tank and packaging. Emulsion tank produce 750kg per hour. So the factory's production capacity is 750kg per hour.
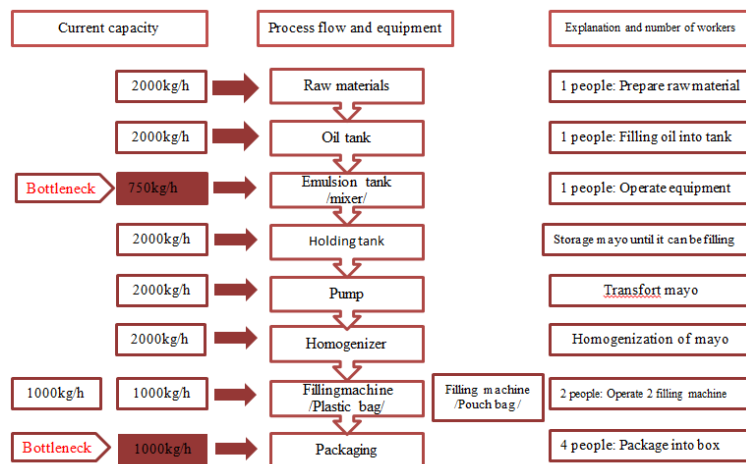

Figure 2. Equipmant and their current capacity

*Bottleneck mixing tank capacity=720kg/h

Calculating capacity utilization of Ulaanbaatar mayonnaise factory After we found the bottleneck we have calculated the capacity utilization offactory. In last year factory's capacity utilization is 85.3%.

Capacity utilization $= \frac{Capacity\ used}{Design\ capacity} * 100 = \frac{1532576}{1797120} * 100 = 85.3$

*Working time: 8 hours day
*Working day: 6 day of week/312 day of year
*Capacity 750kg per hour

Procedures
1. Forecast sales for individual product within each product line

Factory produce 1 flavor of mayo and 2 kind of package that pouch and plastic. The company's sales managers predicted the next five years sales.

Table3. Next 5 years demand

Package	Product type	2019	2020	2021	2022	2023
Plastic bag	1kg	668203	728341	793892	865342	943223
	500gr	501152	546256	595419	649006	707417
Total plastic bag		1169355	1274597	1389311	1514349	1650641
Pouch package	250gr	501152	546256	595419	649006	707417
Total		1670508	1820854	1984730	2163356	2358058

2. Estimate future capacity requirements

Table4. Capacity requirements of each equipment

Current capacuty	Process	2019	2020	2021	2022	2023
2496000	Plastic bag package					
	Percent capacity utilized	47	51	56	61	66
	Machine requirement	0.47	0.5	0.56	0.6	0.66
1	number of required workers	1	1	1	1	1
2496000	Pouch package					
	Percent capacity utilized	20	22	24	26	28
	Machine requirement	0.2	0.22	0.24	0.26	0.28
1	number of required workers	1	1	1	1	1
1797120	Mixing tank					
2336256	Percent capacity utilized	93	101	110	120	131
	Machine requirement	0.9	1.01	1.1	1.2	1.3
1	number of required workers	1	1	1	1	1
4992000	Oil tank					
	Percent capacity utilized	33.5	73	40	43.5	47
	Machine requirement	0.33	0.73	0.4	0.43	0.47
1	number of required workers	1	1	1	1	1
4992000	Preparing raw material					
1	number of required workers	1	1	1	1	1
2496000	Packaging					
4	number of required workers	4	4	4	4	4

We need more or big mixing tank that can produce 2358058kg /2.3 million/ per year.
2358058-1797120=56093

3. Develop and evaluate each alternative and make final choice

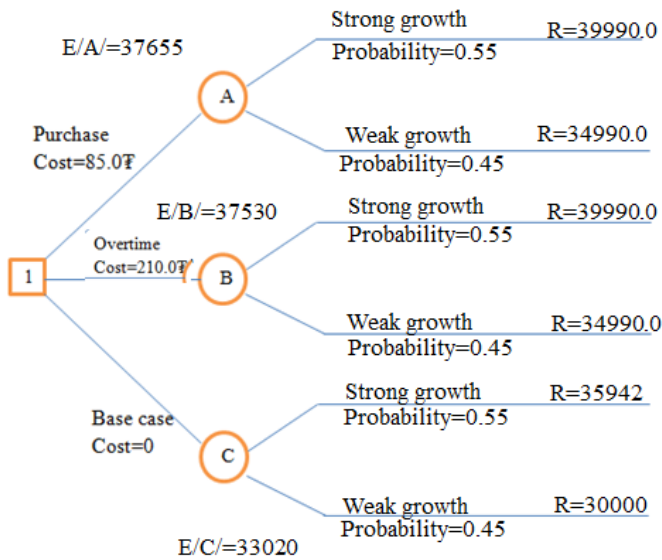We sees three options that increase production capacity of Ulaanbaatar mayonnaise.
A. Purchase new mixing tank
B. Overtime
C. Base case it means do nothing

A decision tree of Ulaanbaatar mayonnaise factory there are three way occurrences (round nodes). Each way has two chance that strong and weak. Then we calculated each options revenue, cost and expected revenue. First way's expected revenue is higher than others. So first way is optimal.

Expected revenue=R strong growth*probability+R weak growth*probability-cost

Table 5. Cost, profit calculation of each way

Total	Price	Cost of production	Total revenue	Total cost	Profit	Additional cost	Net profit
9997506	4000	3500	39990024000	34991271000	4998753000	85000000	4913753000
9997506	4000	3500	39990023977	34991270979	4998752997	93600000	4905152997
8985600	4000	3500	35942400000	31449600000	4492800000	0	4492800000

E/A/=37655

A

Strong growth
Probability=0.55   R=39990.0

Weak growth   R=34990.0
Probability=0.45

Purchase
Cost=85.0₮

E/B/=37530

Overtime
Cost=210.0₮

B

Strong growth   R=39990.0
Probability=0.55

Weak growth   R=34990.0
Probability=0.45

1

Base case
Cost=0

C

Strong growth   R=35942
Probability=0.55

Weak growth   R=30000
Probability=0.45

E/C/=33020

> More 42095300 MNT profit otherwise protect the market from import product
> Company can crease market share

Meet future demands so number of customer will increase Weakness of using this strategy is increasing fixed cost.

D. CONCLUSION

The role of capacity management is
> Provide a plan for the operations
> impact ability to meet future demands
> affects competitiveness.
> The optimal way to increase production capacity of Ulaanbaatar mayonnaise factory is timing and sizing strategy for purchasing new mixing tank. Benefit of using this way:

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