

Machine Replacement in Cooking Oil Bottling Process

Teoh Kah Boon Kevin

Faculty of Engineering, Chulalongkorn University, Bangkok, Thailand

Abstract

This report describes the process of planning and implementing the replacement of a bottling making machine in a cooking oil bottling company in order to increase production capacity, and to reduce production cost. The machine alternatives were identified for the company's preliminary requirements. Justification of the machine alternatives are based on market, technical, and financial analyses. Alternatives were compared with equivalent uniform annual costs and project financing sources for financial consideration and with weighted scoring for intangible factors. Project management approach was then used to implement the chosen option with emphasis on risk management. Post-implementation audit indicates that the project was successfully implemented and yielded the expected benefits.

Keywords: Machine replacement analysis, feasibility study, project management.

Introduction

This report describes the process of planning and implementation of replacement for 1-litre bottle making machine in a cooking oil bottling process in year 2007. This is based on an existing cooking oil bottling company located in Thailand. This process can then be used for future reference for other machine replacement processes and also for practical uses in other companies.

Statement of Problems

The bottle making machine in the cooking oil bottling company needs replacing for the following reasons:

1. Insufficient production capacity which was caused by the bottleneck in the existing bottling process.
2. High cost per bottle because of inefficiency.

Methodology

The methodology that was done follows the steps below.

1. Preliminary requirements were identified for the machine replacement.
2. Research into the various machine options that were available for the company under study to choose from.
3. Machine feasibility study was then done with appropriate criteria. The most feasible option was selected.
4. Planned and implemented the selected replacement option with proper handling of risks.
5. A post completion audit was then done to ensure that the company obtains the full benefits and the project was properly closed out.

Objective

The objective was to plan and implement the replacement of the bottle making machine in order to increase production capacity and to reduce production cost. This was achieved by conducting a feasibility study for option selection and proper planning, execution and control of the implementation.

Machine Replacement Analysis and Design

After the preliminary requirements were identified, machine feasibility study was then done to sort out all the issues and to justify the selection of the option. The study consists of capacity requirements, operational identification, and financial analysis (Baum & Stokes 1985; Chantana & Sirichan 1997; Attaprecha 1999).

Capacity Requirements

A current market research shows that the market has been growing at about 8% average and the latest figures shows that the market has grown by 8.9% in the previous year. This is due to greater contribution in the traditional trade significantly over the years. This trend is most likely to continue in the coming years. However, the market share of the company has decreased by 8% because its demand has exceeded the maximum capacity which is at 180,000 cases per month. Besides, the margin is constantly changing over the years due to the fluctuating price of the crude palm oil world market. To meet the needs of the market is to take full advantage of the market opportunity available by increasing capacity.

Knowing the required capacity to be able to meet the market demand, the machine options were identified and shortlisted to two options. The first option was to replace the existing machinery entirely with a new machine. The second option is to upgrade the existing machinery. The expected capacity of the replacement machine had to achieve about 300,000 cases per month which was in line with the forecasted demand growth identified in the next three years. This was an increase from the previous capacity which was at 180,000 cases per month.

Operational Analysis

Both options took the replacement opportunity to revise the operational procedure to improve efficiency. New layouts were

planned to improve workflows and reduce handling. The number of workers required to operate the new machinery was expected to reduce from 270 to 120.

It was found that the electrical power required for the new replacement at 654 kW was lower than that of the upgrade replacement at 1072 kW. However, it was found that the upgrade replacement was more flexible in terms of size and weight. Both options are able to achieve the desired capacity as identified.

Financial Analysis

The financial analysis covered the options available considering Equivalent Uniform Annual Cost (EUAC), and fund flows. The new replacement gave the lower EUAC at Baht 47.51 mill. compared to Baht 68.44 mill. of the upgrade replacement. The company considered its finance cost to be 15% per annum. This was based on the assumption that all cost items were constant with no inflation.

It was found that the initial cost for the new replacement was Baht 111.72 mill. where as the upgrade replacement would cost 182.280 million baht. The major reason for the higher cost was because the upgrade replacement had to improve and make compatible with the existing system. Another reason was due the higher exchange rate for currency of the country it came from.

The company intended to fund the project from its retained profits. The fund flows of both options were considered acceptable by the company.

Replacement Selection

Apart from financial comparison, several intangible factors were considered in the replacement selection. Weighted scoring was used to analyze overall justification of options based on important selection criteria. Table 1 shows the weighted scoring process. There were five major factors that were considered. Supplier reliability and maintenance were the most important. Next was capacity and

operating cost. Flexibility was also an important factor.

The new replacement machine had several advantages. Firstly, the supplier was well known and had a good reputation for its service. Second, it had the flexibility to change bottle sizes when needed. Thirdly, the supplier would provide much longer maintenance coverage of 10 years for the machine. The only advantage of the upgraded machine was that it was familiar to work with and did not require much additional training. Therefore the company selected the new machinery.

Table 1. Weighted Scoring for Replacement Options (Rating Ranges from 1 to 4).

Factors	Weight	New Machine		Upgraded Machine	
		Rating	Weighted Score	Rating	Weighted Score
Supplier Reliability	25	3	75	3	75
Maintenance Coverage	25	4	100	2	50
Capacity	20	4	80	4	80
Operating Cost	20	3	60	1	20
Flexibility	10	1	10	2	20
Total			325		245

Implementation

The implementation of the replacement was carried out with project management approach. Apart from the usual planning and scheduling of the activities for implementing the machine replacement project, there were several risk issues that needs to be considered. Table 2 shows the risk analysis.

The most significant risk was the disruptions that might occur to existing operations during implementation. The best solution was to keep the operations running at a certain level so as to allow for the new machinery to be installed at the same time. This issue could be mitigated further by having

proper planning by the supplier and the company involved.

The second issue was the project time delay. The project might consume more time than intended. This issue could be solved by allocating extra days for the project and to have the supplier responsible for any significant delays.

The third issue was the accidents that could occur during the construction and execution phase of the project. Arrangements would be made for the contractor to be responsible for those that would happen.

There were two minor issues that have a high probability but low impact. These were lack of training and technical problems. As the machinery would be new, the workers would lack the adequate training to operate the machine properly. To mitigate this problem appropriate training was provided to be able to operate the new machinery. Incentives were provided where appropriate.

Technical problems such as lack of synchronization among the machinery and machine parts breakdown were solved by letting the supplier be responsible for those problems. Additional timing was allocated to solve those problems.

Table 2. Risks Issues Assessment.

Risks	Likelihood	Impact	Priority score (Likelihood*Impact)
Disruption to existing operations	5	5	25
Project time delay	4	5	20
Accidents occurring during construction and execution	5	3	15
Complaint from residents	3	4	12
Lack of training	3	1	3
Technical problems	5	1	5

Results and Discussion

An audit was carried out after the implementation, testing, and commissioning of the selected machinery. The implementation and performance measures were then collected from the bottling line. The implementation measures consist of the number of days delayed, rated speed of the machinery, and the cost involved due to the delay. The performance measures cover the capacity achieved during peak and non-peak times, number of labour utilized, and actual cost incurred per case.

The project suffered a delay of about 60 days but was monetarily compensated for the delay by the supplier. When the overall testing of the machine was completed the new machinery capacity was rated at 300,000 cases per month at 100% efficiency. As the demand is seasonal, the actual production rate of the new machinery would be at 270,000 cases per month during the non peak period and 300,000 cases per month during the peak period.

The actual average cost over the first three months for one case of 12 bottles was at 35.50 baht, slightly over the predicted cost per case at 34.80 baht. The difference was due to rising resin prices, and high carton cost in the first month due to technical difficulties.

The results prove that with the thorough process and appropriate analysis the company made the right decision of selecting the machinery.

Conclusion

The machine replacement process in this project consists of a requirement analysis for machine replacement, system analysis and design, implementation, and post implementation audit as shown in Fig. 1.

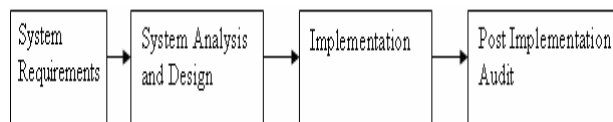


Fig. 1. The machine replacement process.

With proper process of planning and implementing the machine replacement, the company made the right choice and solved its problems effectively. The process shown above was proven to be effective; the company increased the capacity and lowered production cost by 20%. The initial capacity was 180,000 cases per month and cost 44.60 baht per case. After applying the technique the new capacity and cost was at 300,000 cases per month and 35.50 baht per case respectively.

The implementation results show that the machine was performing as expected to meet the demand while keeping the actual cost near to the forecasted cost. The bottleneck in the production line process was also eliminated and as well as the inefficient handling that occurred before. The technique can be applied to other industries for efficient machine replacement.

References

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