Merton truck co

Business, Management

Case Analysis: Merton Truck Company Linear programming techniques can be used to not only determine the best production mix, but also to provide clues and data suggesting ways to improve profits. In 1988, Merton Truck Company was searching for ways to increase profits and ultimately its poor financial performance. Options being considered included changing their product mix by either removing or adding a product line, or renting capacity. In the following pages, the product mix and capacity options considered by Merton are evaluated, other factors and alternatives are discussed, and final recommendations are provided.

Product Mix Based on the financials in 1988, Merton's president suspected that discontinuing their Model 101 would result in stronger financial performance. With unit costs of $40, 205 (including fixed overhead) and a sales price of $39, 000, each sale of Model 101 resulted in a $1, 205 loss. However, the president did not consider that fixed overhead (OH) was being allocated across all units, and the discontinuation of Model 101 would increase the overhead applied to Model 102. In reality, the $8. M in monthly fixed overhead exists regardless of the product mix and does not need to be allocated on a per unit basis to determine overall profit or financial performance. Therefore, fixed overhead was not considered until the end of each evaluation. In order to evaluate any alternative, we need to compare to current profit. Utilizing the data from Tables B and C to obtain production costs per unit as well as fixed overhead, Merton is currently making a profit of $1. 9M (Exhibit 1A). Since it was the specific request of the president, the impact of discontinuing Model 101 was evaluated.

The first step was to determine the capacity of producing only Model 102, which is as follows based on Table A: Engine Assembly4, 000 hours / 2 hours per unit = 2, 000 units Metal Stamping6, 000 hours / 2 hours per unit = 3, 000 units Model 102 Assembly4, 500 hours / 3 hours per unit = 1, 500 units The resulting capacity of 1, 500 units is the same as the current production level, so it was suspected immediately that discontinuing Model 101 would likely have a negative result. Without an increase in sales, discontinuing Model 101 would only result in increasing the fixed costs for Model 102 without increasing the revenue.

As seen in Exhibit 1B, this would indeed result in a $1. 1M monthly loss for Merton. This is a phenomenon known as the death spiral, when the discontinuation of a seemingly unprofitable product causes otherwise profitable products to become unprofitable. Merton should continue to use that extra capacity to produce Model 101 to generate additional revenue and help absorb costs. The impact of making only Model 101was evaluated by determining the capacity using Table A: Engine Assembly4, 000 hours / 1 hour per unit = 4, 000 units Metal Stamping6, 000 hours / 2 hours per unit = 3, 000 units

Model 101 Assembly5, 000 hours / 2 hours per unit = 2, 500 units As shown in Exhibit 1C, producing 2, 500 units of Model 101 results in a $1. 1M loss. However, since the bottleneck is the Model 101 Assembly, additional capacity remains to produce Model 102 units: Engine Assembly1, 500 hours remaining / 2 hours per unit = 750 units Metal Stamping1, 000 hours remaining / 2 hours per unit = 500 units Model 102 Assembly4, 500 hours / 3 hours per unit = 1, 500 units Exhibit 1D shows that producing 500 units of Model 102 results in a $1. 4M profit; however, Merton is still better off in its current situation.

In the current analysis, it is assumed that Model 102 Assembly cannot be used for Model 101, a logical assumptionsince Merton specifies the department where Model 103 will be made. However, if Model 102 Assembly can be used for Model 101, the bottleneck then becomes Metal Stamping at 3, 000 units x $3, 000 CM = $9. 0M - $8. 6M = $0. 4M profit. In a similar fashion, the ability to use Model 101 Assembly for Model 102 would also drastically change the impact of discontinuing Model 101. The bottleneck for producing only Model 102 would then become Engine Assembly at 2, 000 units x $5, 000 CM = $10. 0M – $8. 6M = $1. M profit. So far an improved product mix has not been identified, so linear programming was used to identify the production mix that would maximize profits using the following objective function: To maximize c1x1 +c2x2 Where: x1 = Number of Model 101 trucks to produce x2 = Number of Model 102 trucks to produce c1 = Contribution margin of Model 101 (excluding fixed costs) c2 = Contribution margin of Model 102 (excluding fixed costs) The contribution margins (CMs) were calculated in Exhibit 1 as: c1 = $3, 000 c2 = $5, 000 Subject to Constraints: Engine Assemblyx1 + 2x2 ? 4000 Metal Stamping2x1 + 2x2 ? 000 Model 101 Assembly2x1 ? 5000 Model 102 Assembly3x2 ? 4500 Negativityx1, x2 ? 0 Each constraint was graphed as a line by setting each variable to zero, and then determining which side of the line satisfied the equation by plugging in points (such as the origin). Once the relevant range of all the constraints was determined, the extreme points were clearly identified. The extreme points corresponding to the non-negativity, Model 102 Assembly, and Model 101 Assembly constraints were easy to identify, and the rest was determined by simultaneously solving the equations of intersecting lines.

Exhibit 2 shows the graph, including the values in USD obtained when the extreme points are plugged into the equation. Many of the values were in accordance with expectations as they corresponded to the earlier analyses. The optimal product mix was identified as 2000 units of Model 101 and 1000 units of Model 102, which would generate $11. 0M - $8. 6M fixed costs = $2. 4M profit. The same result was obtained when the analysis was done in Excel Solver (see attached Exhibit 3, Model 101 & 102 Solver Results). The binding constraints seen in Exhibit 4 are no longer the Model Assemblies s seen with earlier combinations, but are now the Engine Assembly and Metal Stamping departments. The optimal product mix for Merton given their current product mix and constraints has been determined, but Merton is also considering the addition of a new Model 103. The values for contribution margin (CM) are given as well as the portion of departmental capacity required to produce 103. Based on the capacity information, it was determined that Model 103 would require 0. 8 hours of Engine Assembly, 1. 5 hours of Metal Stamping, and 1 hour of Model 101 Assembly per truck.

The constraints and objective function were modified with these new values and run in Excel’s Solver, which determined that Model 103 should not be produced (Exhibit 5). Exhibit 6 provides a sensitivity report indicating a reduced cost of -$350, meaning that the CM of Model 103 would need to increase by $350 before it would make sense for Merton to begin producing Model 103. Capacity Options Given the capacity limitations seen thus far, it is a fair conclusion that increasing capacity may present an opportunity.

In the optimal solution, there are limitations in both Engine Assembly and Metal Stamping. If one or both of these was increased, this could have a strong positive impact on profit. By referring to the sensitivity report for the optimal solution found in Exhibit 7, we see that Engine Assembly and Metal Stamping have shadow prices of $2, 000 and $500 respectively, which means that an increase in one unit of capacity would result in the corresponding increase in profit. If Merton can rent capacity for less than the shadow price for either department, it should.

Note that for each, this is only true for 500 units before the scenario would require reevaluation (see the allowable increase in Exhibit 7). Also, only one variable or department can be increased. If both are modified, the shadow prices may no longer hold true. Merton also has the option of increasing engine capacity by 2, 000 hours using overtime. This would also result in a 50% increase in direct labor or: Model 101$4, 000 current from Table B x 1. 5 = $6, 000 (reducing CM by $2, 000) Model 102$4, 500 current from Table B x 1. 5 = $6, 750 (reducing CM by $2, 250) In the overtime tab (Exhibit 8), we add two additional variables epresentative of overtime production o1 and o2, including an additional constraint representing the maximum of 2000 hours. As seen in Exhibit 8, Solver has determined that overtime should be utilized to produce 250 additional units of Model 102. However, fixed OH has not been included in the calculations until afterwards as it does not impact the optimal solution, only the net profit. In this case however, the fixed overhead increases by $0. 75M to $9. 35M if overtime is utilized. Therefore, the $9. 35M is subtracted from this result and compared to our previous optimal solution net profit of $2. M. This was done in Exhibit 8, resulting in a net profit of less than $2. 4M. Therefore, Merton should not assemble engines on overtime under these conditions. Other Factors, Alternatives and Considerations Merton's president would like to impose a marketing mix constraint requiring Merton to produce at least three times as many units of Model 101 as units of Model 102. By adding this constraint to the analysis in Exhibit 9, the marketing mix moves to producing 2, 250 units of Model 101 and 750 units Model 102, and a net profit of $1. M . The marketing constraint hinders the potential total net profit by $500, 000 because at optimal production levels, Merton will be able to produce a total net profit of $2. 4M. There are several other options that Merton did not consider. Renting capacity from an outside supplier was one alternative, but a similar option would be to simply outsource (at a rate less than the shadow prices discussed earlier). It is also mentioned that at present, demand is great enough that the company is selling everything it produces.

How much greater than supply is the demand? If it is much greater, Merton should consider raising its prices to reduce demand. If demand is expected to continue, Merton should also evaluate the ROI of investing in capital and permanently increasing capacity as an alternative to renting or outsourcing capacity. Merton should also consider the impact that learning curves andtechnologymay have on their production process. As the Model 101 and 102 life cycle continues, the company should see a reduction in time and costs associated ith every aspect of the truck manufacturing process as a result of learning curves. It can be reasonably estimated that labor hours per vehicle will be reduced due to learning curves (which result from staff experience and familiarity with the production process), and that Merton will therefore be able to increase the total volume of vehicles produced. Technology could also play an important role in reducing the time and costs needed to produce the vehicles, so it is important that Merton maintain a watchful eye on new production methods and machinery.

Investments in technologies can reduce the firm's fixed overhead costs and increase profits and improve productivity. In addition, technologies can help reduce the costs of designing, developing, and manufacturing a product which can help the firm to improve product quality and to charge a higher price. Conclusion Merton's president was absolutely correct in his supposition that the company could improve its financial performance by changing their product mix, though wrong in his initial thoughts on which actions to take.

The value of linear programming techniques in evaluating possible solutions is clear, particularly in that it quickly provides clues of other options to consider (such as adding additional Engine Assembly Capacity). Based on the information provided here, further recommendations for Merton would be to (1) immediately change the production mix to 2000 Model 101s and 1000 Model 102s, (2) evaluate anticipated demand and the impact of a capital investment to increase capacity, and (3) seek quotes for capacity rental or outsourcing Engine Assembly.