JUICING THE NUMBERS: FINAL REPORT

MC MANAGEMENT CONSULTING

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Introduction

Pure Fresh (the Client) are a juice manufacturer seeking to optimise their delivery operations. The scope of this report was to;

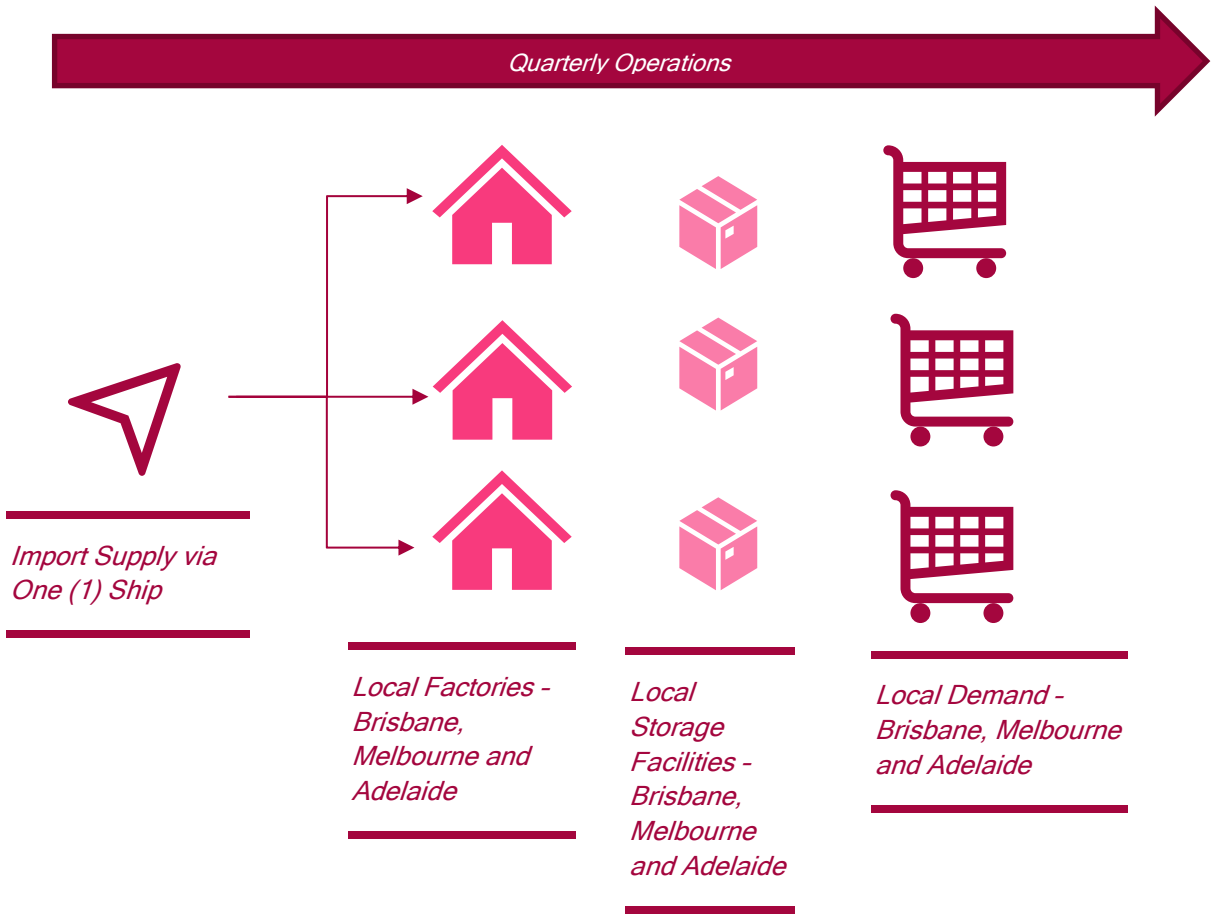
(1) Model Pure Fresh's in-scope operations detailed in Figure 1

(2) Collaborate with the Client in order to better under their constraints and limitations

(3) Within those constraints find a solution to maximise profit

(4) Make recommendations

Figure 1



Methodology

STEP 1: MODEL OPERATIONS

There are two varieties of cost for Pure Fresh with respect to their delivery operations. Specifically, the cost to deliver each barrel to meet the demand of a customer, and secondly, to store barrels while that demand is not there.
The objective of the model, simply put, is to reduce the costs of product delivery which, in effect, will seek to minimise each of these components.

STEP 2: COLLABORATE WITH CLIENT TO REFINE CONSTRAINTS

Throughout the term of this consultancy, the model was refined in response to further communications from the client.

The initial model, Scenario 1, was subject to the following constraints:

Table 1

Type of Constraint	Constraint
Initial barrels of FCOJ in storage	Brisbane has 3200; Melbourne had 4000 and; Adelaide has 3800 barrels.
Import Ship	Has capacity of 10000 barrels
Non-negativity	There cannot be negative demand (i.e. customers cannot sell juice back to Pure Fresh). There cannot be negative storage

Furthermore, the model was constructed with 100% efficiency. At the conclusion of each quarter, the number of barrels in storage was equal to the sum of the initial number of barrels there and those added, minus those lost due to sale. There was no accounting for waste. Similarly, modelling over individual quarters may ignore the reality of the operations whereby shipments may not arrive on the 1st of every quarter, or where storage for 1 day into the following quarter may not cost the same as storage for 50 days into the following quarter, for example.

Upon further communication with the client, the following constraint was added in Scenario 2:

Table 2

Type of Constraint	Constraint
Must finish forecast period with a specific number of barrels	Each port must conclude with 3000 barrels in storage.

The final refinement of scope has been defined as Scenario 3. Here, Pure Fresh detailed the maximum storage capacity of their facilities. The following constraint then occurred:

Table 3

Type of Constraint	Constraint
Maximum Storage Capacity of facilities	The storage facilities are capped to the following amount of barrels of concentrate: Brisbane – 3900 Melbourne – 5500 Adelaide - 6700

Results

The model met the needs of the Client. It was able to provide the optimal cost of delivery over the forecasted eight quarters, in each scenario.

In Scenario 1, the optimal cost of delivery over the period is $43704050.
This is achieved through the following deliveries and storage use plan, Tables 4 and 5.

Table 4

Barrels Delivered for Scenario 1			
Quarter	**Brisbane**	**Melbourne**	**Adelaide**
Q1	0	2200	7800
Q2	3200	6800	0
Q3	0	0	0
Q4	4150	300	0
Q5	0	0	0
Q6	1950	5850	2200
Q7	2600	700	1850
Q8	2700	1350	1950

Table 5

Barrels Stored for Scenario 1			
Quarter	Brisbane	Melbourne	Adelaide
Q1	1400	3800	8400
Q2	2500	7200	6600
Q3	0	4400	4900
Q4	1750	2500	2500
Q5	0	0	0
Q6	0	2250	0
Q7	0	0	0
Q8	0	0	0

In Scenario 2, following the Client's addendum to the scope such that 3000 barrels of concentrate must be stored at the conclusion of the term, the optimal cost of delivery totaled $53169450. This addendum resulted in an increase of costs of approximately 21.7%, or $9465400. This is a significant cost increase.

The optimal profit scenario based on these constraints is detailed in Tables

Table 6

Barrels Delivered for Scenario 2			
Quarter	Brisbane	Melbourne	Adelaide
Q1	0	2200	7800
Q2	7500	2500	0
Q3	0	0	0
Q4	0	4600	0
Q5	0	0	0
Q6	4200	3600	2200
Q7	200	7300	2500
Q8	5700	0	4300

Table 7

Barrels Stored for Scenario 2			
Quarter	Brisbane	Melbourne	Adelaide
Q1	1400	3800	8400
Q2	6800	2900	6600
Q3	4300	100	4900
Q4	1900	2500	2500
Q5	150	0	0

Q6	2400	0	0
Q7	0	4350	650
Q8	3000	3000	3000

Finally, when the limitations of the storage facilities were implemented, the optimal cost of delivery was evaluated to be $53177650. Comparatively, these constraints further increased the cost of Scenario 2 by $8200. The optimal cost of delivery in this scenario is $9473600 more expensive than Scenario 1.

Table 8

Barrels Delivered for Scenario 3			
Quarter	Brisbane	Melbourne	Adelaide
Q1	0	3900	6100
Q2	4600	3400	1800
Q3	0	0	0
Q4	2750	2000	50
Q5	0	0	0
Q6	1950	3600	4450
Q7	6500	3500	0
Q8	1800	3800	4400

Table 9

Barrels Stored for Scenario 3			
Quarter	Brisbane	Melbourne	Adelaide
Q1	1400	5500	6700
Q2	3900	5500	6700
Q3	1400	2700	5000
Q4	1750	2500	2650
Q5	0	0	150
Q6	0	0	2400
Q7	3900	550	550
Q8	3000	3000	3000

Recommendations

There are a number of recommendations to be made in light of the results presented.

First, the business case of Scenario 2 must be questioned. By mandating 3000 barrels of concentrate in storage at the conclusion of the forecast period, the cost of operations for Pure Fresh will increase by approximating 21.7%. Considering that prolonged storage of concentrate creates a cost in and of itself, the necessity of this constraint ought be challenged.

This is supported through the evaluation of what the optimal cost would be when the storage capacity restrictions detailed into Scenario 3 are applied to Scenario 1, without the constraint of Scenario 2. When the constraint of requiring 3000 barrels to be held in storage at the conclusion of the term is removed, the optimal cost is $43716350. In short, the effect of Scenario 3 constraints, without the limitations of Scenario 2, only increase the cost of delivery of $12300. Clearly then, the Scenario 2 constraints must be reconsidered.

The consultants ran sensitivity analysis on the constraints provided by the Client in order to ascertain the most important of these to remove or otherwise improve. The dual variable represents the gap between the current feasible solution and the optimal solution possible for that particular constraint.

The dual variable results then, are detailed in Table 10.

Table 10

Constraint	Dual Value (absolute value) Summed over all Quarters
Initial Supply	2628
Demand	21234
Ship Capacity	274
Port Maximum Capacity	123

From this data then, it can be seen that the highest impact variable with respect to delivery cost is the demand forecast. It is the Consultant's recommendation that investment in this area, for example investment in marketing or packaging, is necessary.

Note that payoff due to higher demand rises progressively from a low of an extra $901 per barrel sold in Q2, to an extra $1092 per barrel in Q8.

The Client should prioritise business development in light of these sensitivities. A large gap between the feasible solution and optimal solution, a large dual value, for a particular constraint represents a large potential for profit maximisation. We would recommend optimising delivery operations in the order of largest dual value to smallest. In order of relative efficiency of investment then, the consultants would recommend addressing demand, initial supply, ship capacity and then port maximum capacity.

Of course, the profitability of particular changes, such as increasing the Storage Capacity, must be traded off against the costs of such action. Such analysis is beyond the scope of this Report, but ought to be pursued by Pure Fresh.

Visibility of operations, and an understanding of the impact of constraints, are critical in understanding the present operations and enabling strategic long-term planning. It is hoped that Pure Fresh will be able to significantly improve their delivery operations in light of this report.