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Technical Marketing Case Study
BlendOpt | NSW Coal Exports

1. Executive Summary

This report summarises selected findings from a marketing study that was completed for a coal mine in New South Wales, Australia. Our study investigated the financial impact of modifications in export product definitions as well as the financial impact of export product consolidation.

It explored whether existing thermal export product definitions are well aligned with the coal mine's distribution of coal energy, ash, and washability, given the current negotiated mining schedule as well as supply chain constraints and various contractual commitments.

This study also investigated whether a smaller consolidated product set could replace the existing product set while achieving a financially similar outcome for the mine. Production consolidation was an area of interest as it is expected to confer many practical benefits associated with operational and business process simplification.

The integrated planning model used within this study accounted for detailed operational and business constraints that enabled a high degree of financial estimation accuracy within a technical marketing study. Considerations included published coal mining schedules, dynamic CHPP and supply chain modelling, coal washability data, sales contracts, product quality targets and acceptance ranges, price forecasts, and quality-based price adjustment factors.

The following noteworthy observations resulted from this study:

- A 2.7% increase to CV in the highest volume thermal product corresponded with a **8.4% overall profit improvement** for the coal mine.
- Two new product definitions were able to replace all five existing export products with a remarkable **eight-month profit improvement of 14.3%**.

The product consolidation results are particularly noteworthy given the trade-offs that are typically expected between reductions in the number of unique products and theoretical profitability afforded from product diversity.

2. Introduction

2.1 Aims

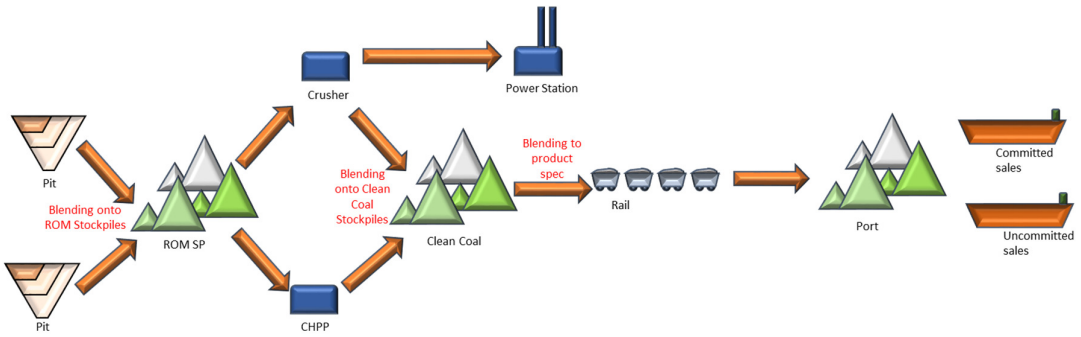
The aim of this project was to undertake an accurate technical marketing study whose purpose was to align marketing and operational planning. The study was conducted as a three day time-boxed exercise to demonstrate how BlendOpt Integrated Planning Software can be used to rapidly explore a specific question and build a business case for improving alignment between market conditions and supply chain operations.

Experiments focused on adjustments to the quality specifications of export thermal coal products. The chosen set of product adjustments were motivated by an initial analysis that investigated the distribution of optimised product volumes and associated product definitions (see Methods).

2.2 Study Validity

A BlendOpt integrated planning model was developed for this client including several model constraints found to be essential to the accurate alignment of marketing and operational planning. The integrated planning model included client mine scheduling data and costs, ROM stockpile blending and constraints, crushing and CHPP processing rates and availability, coal washability data, post-CHPP stockyard blending models, conveyor and railing constraints, committed sales contracts, product quality acceptance ranges, product pricing forecasts, and quality-based price adjustment factors. A simplified illustration of the supply chain is shown in Figure 1.

Figure 1 Integrated Supply Chain Model.



This integrated planning model was designed to support a range of strategic as well as operational business decisions as well as planning processes for the client, meaning that some model features were noncritical to the findings of this particular study. For the sake of brevity, these additional model details will not be elaborated upon here.

3. Results and Conclusions

A number of experiments were conducted whereby one or more existing products were replaced with new products having a modified quality acceptance specification and associated modifications

in pricing forecast (see Methods). A presentation of all results is outside the scope of this report and only selected results are reported in this section.

Among the product replacement experiments, the most noteworthy are the single product and two product replacement experiments reported in Table 1. For experiment EXP-7 (Single Product Replacement), product 5950 was replaced with a new product 6100. The new product specification requires a small 150 kcal/kg (2.7%) increase in minimum CV. Running BlendOpt on this new problem definition results in an optimised product strategy with an 8.4% increase in total profit over eight months. Experiment EXP-7 displayed the most pronounced profit uplift, however other single product replacement experiments also exhibited opportunities for improvement.

For experiment EXP-3 (Two Product Replacement), product 5950 was replaced with a new product 6100 and product 6200 was replaced with new product 6300 resulting in an 11.4% increase in total profit over eight months.

Table 1 Performance Metrics of Optimised Plans for Selected Experiments. Confidential information has been removed.

Description	Test ID	Profit ($M)	Profit Increase (%)	Product Tonnage (MT)	Unsold Coal (MT)
Baseline	Baseline	XXX		XXX	XXX
Single Product Replacement	EXP-7	XXX	8.39	XXX	XXX
Two Product Replacement	EXP-3	XXX	11.65	XXX	XXX
Product Consolidation	EXP-14	XXX	14.29	XXX	XXX

In our view, the most noteworthy finding from this study is shown in experiment EXP-14 where two new products replace all five existing export products (Product Consolidation). This result displays a considerable profit increase of 14%, yet also presents a remarkably simplified marketing strategy. Results analysis suggests that the origins of the observed profit improvement are likely derived from a better alignment between product definitions and the Ash-CV-Yield relationship of mined coal.

As indicated in the last column of Table 1, it is also worth noting that improvements to market strategy discovered within these experiments typically corresponded with modest increases in the total volume of unsold coal. If model constraints forced the sale of all ROM coal, this impacted the findings of this study, particularly for experiments that alter the existence of low energy product definitions. This conclusion is not surprising within the context of this study, as current market conditions were generally known to be unfavourable for certain plies.

Additional experiments (not shown) indicated that quantitative results and conclusions are sensitive to cost modelling assumptions, particularly as costs approach parity with revenue for select product definitions. This is an expected outcome, however it highlights the importance of accurate financial modelling, particularly under tight market conditions.

The key insights that were summarised within this study are unexpected and potentially could have considerable impact to the client. Prior to communicating these results to a wider stakeholder

audience, we advised the client to use an independent 3rd party consultancy to validate these findings. In addition, we advised the client to use their BlendOpt software license to extend this study to include:

- Inclusion of a more comprehensive cost model to validate robustness of reported results to different cost assumptions.
- Evaluation of result sensitivity to alternative price forecast scenarios.
- Experiment replication on additional mine schedules using relevant marketing planning time horizons.

4. Methods

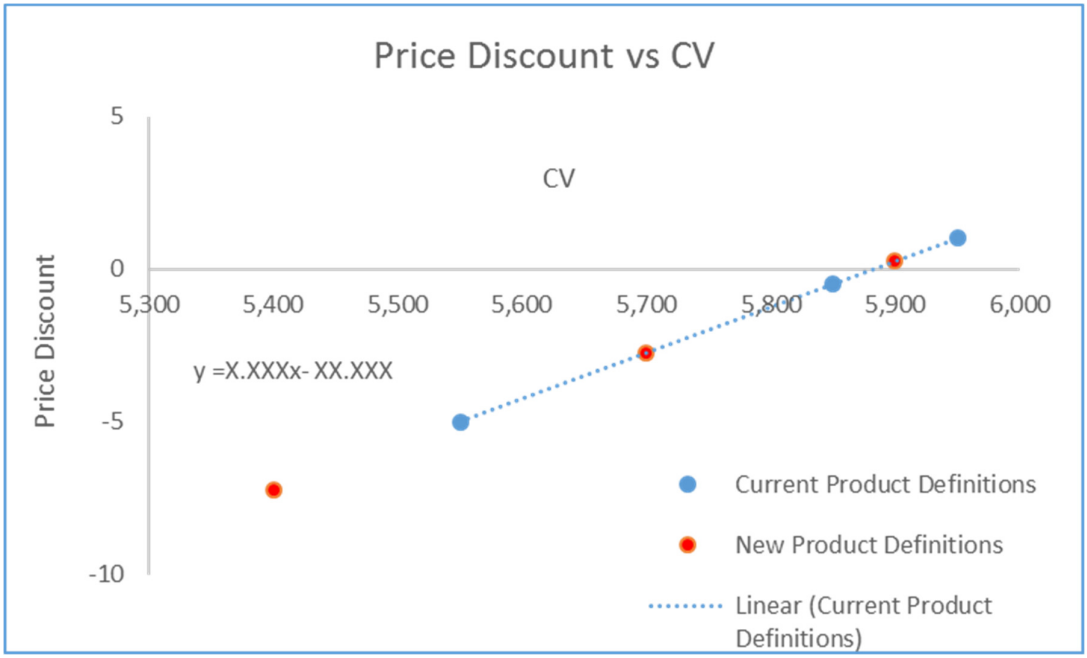
4.1 Constraints & Conditions

- Model Definition: CONFIDENTIAL
- Mine Schedule: CONFIDENTIAL

4.2 New Product Modelling

As shown in Figure 2, pricing discounts for Newcastle indexed thermal products (e.g. 5950, 6250, 6200, 6350) exhibit a strict linear relationship with product CV acceptance ranges. It is therefore expected that any interpolated thermal export product will similarly adhere to the linear function specified within Figure 2.

Figure 2 Price Discount as a Function of Minimum Product Energy for NEWC-indexed products



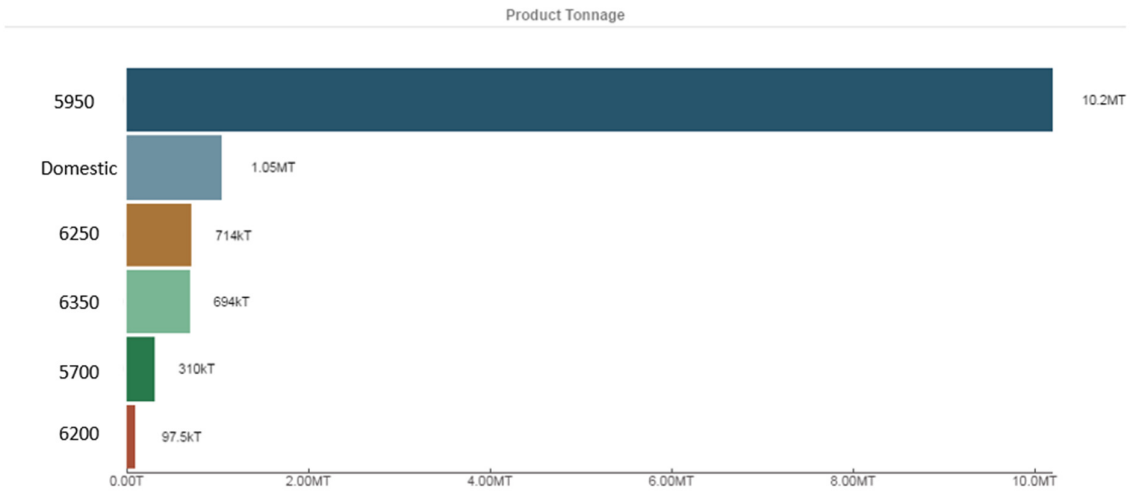
Other quality attribute ranges (Moisture, VM, S) were derived in this study by linear interpolation of the two current products most similar in energy. This “locally linear” assumption is a close

approximation to quality targets that would be negotiated by a marketing team (analysis not shown). Moreover, small deviations from these assumptions are expected to have a trivial impact on the final results due to the fact these quality attributes are rarely active constraints within customer's optimal marketing plans (results not shown).

4.3 Definitions of New Products

Experiments that were restricted to the existing product definitions displayed optimised results with consistently high volumes of product 5950 and consistently low volumes of minimum energy (5700) and maximum energy (6350) products. An indicative example is shown in Figure 3.

Figure 3 Eight-month product volumes within a typical optimised plan



Given the high volumes of product 5950 and low volumes of 5700, we anticipated that product strategy improvements were unlikely to involve new products with CV lower than 5950's specifications. Thus, most tests in this study involved new product definitions with CV ranges between the 5950 and 6350 products, namely the new 5800 and 6300 products shown in Table 2.

To reduce the number of new products to consider in this study, we used an equidistance interpolation to define any new products (see Figure 2), which greatly reduces the number of new products that can be defined. In particular, new product 6100 is an exact equidistance specification between products 5950 and 6250, while new product 6300 is equidistant to products 6250 and 6350. In addition, some tests also involved new product 5800 which was created by extrapolation of products 5950 and 6250.

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Table 2 Export Product Specifications (new products shown in red). All data values, labels, and discounts have been significantly obfuscated to protect the client.

Export Products	Price Adjustment	Moisture		Ash		VM		CV		S	
Brand Name	**NEWC Discount**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**	**Min**	**Max**
6350	1	0.00%	12.46%	0.00%	15.23%	27.69%	38.76%	6,350	6,792	0.00%	0.70%
6250	-0.5	0.00%	11.96%	0.00%	17.13%	26.57%	38.15%	6,250	6,673	0.00%	0.71%
6200	-0.5	0.00%	11.99%	0.00%	17.13%	26.54%	37.64%	6,200	6,595	0.00%	0.71%
5950	-5	0.00%	11.51%	0.00%	20.55%	25.23%	37.00%	5,950	6,336	0.00%	0.97%
5700	NA	0.00%	11.54%	0.00%	23.97%	24.34%	35.40%	5,700	6,187	0.00%	0.97%
New 5800	-7.25	0.00%	11.28%	0.00%	22.26%	24.56%	36.42%	5,800	6,167	0.00%	1.09%
New 6100	-2.75	0.00%	11.73%	0.00%	18.84%	25.90%	37.57%	6,100	6,504	0.00%	0.84%
New 6300	0.25	0.00%	12.21%	0.00%	16.18%	27.13%	38.46%	6,300	6,733	0.00%	0.70%

4.4 Test Coverage

Given the time-boxed nature of this study, a systematic Design-Of-Experiments approach to test coverage was not conducted. Instead, the test coverage shown in Table 3 was generated using an exploratory procedure whereby each new test condition was motivated by the findings of previous tests. Note that only selected results from the tests below are presented within this report.

Table 3 Product combinations for each experiment.

Product	5700	5800	5950	6100	6250	6200	6300	6350	Domestic
Baseline	x		x		x	x		x	x
EXP-1	x		x	x	x	x		x	x
EXP-2	x		x		x	x	x	x	x
EXP-3	x			x	x		x	x	x
EXP-4	x		x	x	x		x	x	x
EXP-5	x		x	x	x		x	x	x
EXP-6	x		x		x			x	x
EXP-7	x			x	x	x		x	x
EXP-8	x	x			x	x		x	x
EXP-9	x	x		x	x	x		x	x
EXP-10	x	x			x	x	x	x	x
EXP-11				x			x	x	x
EXP-12	x			x			x	x	x
EXP-13	x			x			x		x
EXP-14				x			x		x

4.5 Hypotheses

Hypothesis 1: The current set of thermal export product definitions is optimally aligned with the mine site's distribution of coal energy, ash, washability, and associated mining schedule. Evidence that potentially contradicts this hypothesis is found in the distribution of product volumes (Figure 3) as well as additional results analysis (not shown).

Hypothesis 2: A smaller product set cannot replace the existing product set while achieving a financially competitive result for the client. Evidence that potentially contradicts this hypothesis is found in the distribution of product volumes (Figure 3) as well as the linear relationship between price and CV (Figure 2).