



Paradyn

Paradyn Systems

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# Capability Statement

**Issued by:**

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## Executive Summary

Paradyne delivers technically rigorous answers and novel insights into important decisions faced within complex mining value chains. We help mines make great decisions from the tactical scheduling of on spec shipments to strategic acquisitions and mine expansion studies. Paradyne's services are fundamentally supported by BlendOpt- our proprietary cloud-based platform for integrated planning and scheduling of complex mining value chains.

BlendOpt uncovers unique solutions and communicates complex results with impactful visualisations that resonate with the mine engineer to the COO. For instance, see the video on our website <http://www.paradynsystems.com>. Each system is designed to support a variety of studies, planning activities, and user groups that each may have very unique aims and purposes. Paradyne also offers the fastest software implementation time within this market. In most cases, we deploy a BlendOpt system within a few weeks which allows us to offer low risk and low-cost pilot studies for new customers. In contrast, competing vendors typically require many months to deploy systems of similar complexity.

BlendOpt can simultaneously optimise many thousands of decisions across time to uncover opportunities for higher operating profits. The specific details of each system are often very different as each BlendOpt system is custom-configured to meet the unique needs of an operation. Optimisation decisions are often related to stockpiling, processing, blending, rail, port, and product strategy. Many applications of BlendOpt focus on 2 or 5-year plans, however BlendOpt is also regularly used in LOM and strategic planning as well as detailed daily scheduling.

### Example Studies & Topics

ore processing strategies, DMC cut point optimisation, primary/secondary product optimisation  
stockpiling strategy optimisation

multi-mine supply chain integrated planning

market strategy optimisation including contracted sales and pricing penalties

port scheduling

Mine to CHPP, Mine to Mill, Mine to Rail, CHPP to Port planning

new product studies

minimizing ROM rehandle costs

3rd party coal purchasing studies

Take or pay rail contract studies



## Paradyne's Team

Paradyne's team of data scientists and consultants have diverse backgrounds in artificial intelligence, optimisation, machine learning and data science with many years' experience solving real world problems. The members of the team have a proven track record of successfully leading the design, implementation, and 'go live' rollout of complex intelligent systems that involve autonomous agent-based systems, optimisation, planning, simulation, prediction and forecasting. The team's domain expertise is particularly strong in the areas of supply chain integration for mining, food and beverage, Defence, and chemical industries. These factors make Paradyne ideally suited to assist with ongoing efforts in advanced data analytics and working towards the goal of autonomous mine sites.

In particular, Paradyne can assist with resolving the following specific technical challenges:

**Data:** Raw data gap analysis, data transformation requirements and robust system performance under conditions of imperfect and unpredictable data quality.

**Intelligent Systems Integration:** Integration of decision support within multi-tier systems comprised of AI, ML, simulation, and optimisation modules.

**Temporal Integration:** Integration of fine granularity (short-term) and coarse granularity (long-term) planning systems.

**Silo Integration:** Integration of co-dependent agent-based and material-based subsystems with unique and potentially conflicting objectives.

**Future Proofing:** Architectural design principles that facilitate innovation and growth within multi-systems.

**Return on Investment:** Ensuring the existence of suitable stepping stones that utilise already implemented technologies to not only demonstrate their efficacy under real conditions but also to demonstrate financial benefits and to fund future extensions.

## BlendOpt Technical Capabilities

BlendOpt can accommodate the following conditions:

Time granularity of optimisation is configurable (e.g. weekly, monthly, quarterly, yearly).  
Configurable start and stop dates for optimisation of a small-time window within a larger set of mine plan data.

Optimisation objective can be defined as revenue, profit margin, or NPV.

Simultaneous optimisation of 20+ products that are each specified by 10+ chemical and physical quality attributes.

Optimisation of decisions to bypass or processed ROM. For processed ROM, optimisation of decisions for cyclone cut-point or other process control decisions. Cut-points can be defined as identical for all material blended into a product in the same time interval or cut-points can be different for each ROM type that is processed and added to a product for each time interval.

Sales prices that change over time as well as penalties related to impurities.

Costs for process plant utilisation, bypass, and rail (e.g. fixed and variable costs).

Plant feed rates can vary between ROM types.

Adherence to mine production plans.

Constraints that specify specific ROMs (or seams or pits) that can only be considered for use in a particular product.

Capacity constraints for stockpiles (min and max tonnage per time period), processing plants (Max capacity per time period), and rail (Max capacity per time period).

Satisfaction of contractual product tonnage requirements.

Size of material units that are added into a blend can be constrained to fit a specific raw tonnage in order to reflect truck sizes, e.g. 300T.

Optional reserving of materials for future periods of time to achieve better CHPP utilisation, lower costs, and higher revenue outcomes. Configurable constraints on the amount of time that material can be held in a stockpile before being sold.

Automated material quality changes that model the aging of coal on stockpiles (e.g. fluidity).

Materials sourced from multiple pits or mine sites, each with distinct capacity constraints.

Option to define stockpiles for both ROM (pre-CHPP) and product (post-CHPP)

Optimisation results within 5 minutes. Multiple optimisation scenarios can be executed simultaneously without impacting the runtime of each single optimisation execution.



## Services and Advisory

Paradyn services are offered within the following areas:

### **Strategic Advisory Services | Complex Intelligent Systems**

- Multi-Systems/Complex Systems Framework Design
- Systems Integration
- Technology Roadmap Planning
- Technology Stack

### **Data Exploration Services**

- Data Discovery
- Pattern Analysis
- Data Quality Assurance

### **AI/ML Model Advisory and Design**

- Bespoke bottom up design as well as toolset implementation for SVM, NN, PCA, K-NN, SOM, RL, LCS, etc
- Tool selection, technology trends and technology investment advisory

### **Business Intelligence Advisory and Design**

- Visualisation Insights and BI Design

## Paradyne-Client Case Study | Selected Examples

### TRACTION - CO-INVESTMENT CASE STUDIES

|                            | Case study 1              | Case study 2                         | Case study 3a                      | Case study 3b           | Case study 3c                      | Case study 4            | Case study 5                                |
|----------------------------|---------------------------|--------------------------------------|------------------------------------|-------------------------|------------------------------------|-------------------------|---|
| Context                    | Plant & Product           | Plant capex                          | Product strategy                   | Rail & port contracts   | Sales Contracts                    | 3 mine product strategy | Ply grouping & sales                        |
| Insight                    | Eliminate Premium Product | Modest change to plants and products | Consolidate products, new products | Increase exports volume | New strategy for domestic delivery | Change to product mix   | Change to working sections and sale targets |
| Potential revenue increase | \$24M/yr                  | \$8M/yr                              | \$14M/yr                           | \$9.4M/yr               | \$23M/yr                           | \$54M/yr                | \$21.5M/yr                                  |



## Met Coal Consistency Study

An open pit + underground multi-seam coal mine sold a number of metallurgical coal products. There was a particular coal quality attribute that was sometimes difficult to control in product blends but that was important to coal buyers. The mine's parent company engaged Paradyne to determine if a more consistent product quality could be achieved through stockpiling and processing strategies without making changes to the mining schedule, which was constrained and had limited optionality.

The planning problem was defined such that sales volumes for each product were fixed, so opportunities for improvement were not in relation to production yields or margin and instead related to the delivery of products within a narrow quality specification.

Using a combination of stockpile definition changes, processing strategy, and blending strategy, BlendOpt delivers plan that violate product specifications in <5% of targets in comparison to a previously existing plan that violated specifications in ~35% of targets across a five-year plan. Importantly, BlendOpt did not violate any quality specifications that were hard constraints for product sale.

## Stockpile Definitions Study

A coal mine wanted to investigate whether changes to ROM stockpile capacities would allow for a higher margin for their operation. It was often the case that the operation would be forced to sell products that exceeded quality requirements and would thereby destroy value. Changes to the mining schedule were limited in optionality and created other challenges that were not articulated to Paradyne.

Site technical services believed that some stockpiling of selected coals might alleviate the issue and wanted to know how large the stockpile capacity needed to be and whether benefits could be achieved from changes in stockpile definitions.

The decision to stockpile ROM needed to be balanced against rehandle costs and some coals also could not be stockpiled for long due to rapid loss in fluidity. The mine site already had a BlendOpt license that was used for monthly planning exercises and which was used for the purposes of this study.

BlendOpt was used to run a range of scenarios to evaluate different supply chain conditions. While Paradyne staff were not actively engaged in the project, it is understood that the client decided to implement a moderate change in stock capacity along with several changes in stockpile definitions.



## Case Study-Wash vs Bypass + Product Strategy Thermal Coal Mine

A coal mine in Australia was selling three thermal products. Prior to using BlendOpt, every spreadsheet analysis had indicated that maximizing volume of their low ash thermal product was the best strategy due to the premium pricing of that product. In particular, there appeared to be reasonable losses in yield from washing that were more than compensated for by the price premium.

BlendOpt discovered a very different product strategy that reduced washing costs and improved revenue by \$24M per year. With the exception of a small contract that needed to be delivered, BlendOpt entirely eliminated the premium product with almost all coal pushed into a higher yielding mid-ash product. BlendOpt also eliminated the high ash product, which was purportedly difficult to sell.

## Customer Reference List

|                |          |
|----------------|----------|
| Adaro          | Idemitsu |
| Anglo American | Peabody  |
| Batchfire      | Vale     |
| Bathurst       | Yancoal  |
| BHP Billiton   |          |