Paradyn

Paradyn Systems

Capability Statement

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Executive Summary

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

BlendOpt uncovers unique solutions and communicates complex results with impactful visualisations that resonate with the mine engineer to the CEO. For instance, see the video on our website http://www.paradynsystems.com. Each system can be reconfigured by the user to support a variety of studies, planning horizons, and user groups that each may have very unique aims and purposes. Paradyn also offers the fastest software implementation time within this market. In most cases, we deploy a BlendOpt system within a 2-6 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 is a solution platform that makes integrated planning and scheduling decisions of material from Mine to Market or a subset of the value chain. Paradyn's software uses mathematical optimisation to simultaneously optimise many thousands of interdependent decisions in a supply chain with end to end visibility as opposed to a "black box" result. We use a scalable cloud service that enables our software to be used for small operations as well as large mining complexes. Tangible benefits are delivered of increased Revenue, Margin and Yield, often in the range of 4-11%.

Solution Approach

Paradyn Systems has been providing the BlendOpt solution to clients since 2012, our team has delivered many successful deployments to clients - including Idemitsu, Peabody, Vale, and BHP - for several years.

BlendOpt provides complete material flow traceability from Mining Block to Vessel. It allows for rapid data queries using an interactive analytical charting system. Being cloud based the solution can be scaled easily both up and down when required.

The BlendOpt solution is designed around scalability and flexibility, the customer can increase and decrease their use of the system through the flexible license structure. Multiple users with various hierarchical levels of authority can both manipulate and view the system concurrently. The solution also lends itself quite readily to customisation and additional modules can be added. After training and configuration, typical users are up and running with the solution in two to four-week timeframes. Existing client planning methods that take days to complete can be achieved in BlendOpt in minutes saving time, effort and data duplication.

Our engagement approach is based around controlled stages, both in risk and financial outlay to the client, ensuring deliverables are met at each milestone before continuing on. It should be also noted that there is no disruption to the current daily work practises and systems currently being used by the client. BlendOpt can be ran fully independent of the current systems.

Paradyn Team

Our team consists of experienced management, project leaders, data scientists and consultants with diverse backgrounds in mining, engineering, chemistry, 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 many projects with 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 Paradyn ideally suited to assist with ongoing efforts in advanced data analytics and working towards the goal of autonomous mining supply chains.

BlendOpt Technical Capabilities

Paradyn's customer experience and capabilities include:

- Ore processing strategies, DMC cut point optimisation, primary/secondary product optimisation;
- Stockpiling strategy optimization, Minimising ROM rehandle costs;
- Multi-mine supply chain integrated planning;
- Market strategy optimisation including contracted sales and pricing penalties;
- Port scheduling, New product studies, 3rd party coal purchase optimisation;
- Mine to CHPP, Mine to Mill, Mine to Rail, CHPP to Port planning and
- Take or pay contract planning.

Examples of Technical Requirements Paradyn has delivered include:

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, NPV, or constraint satisfaction.

Simultaneous optimisation involving large numbers of contracts, stockpiles, quality attributes, and process decisions.

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 or volumes.

Costs for process plant utilisation, bypass, reagents, rejects, and rail (fixed and variable costs).

Plant feed rates can vary between feed types or added as an optimisation decision that impacts recovery yield.

Strict adherence to mine production plans with no negative inventories.

Constraints that specify specific ROMs (or grades, benches, blocks, pits) that can only be considered for use in a particular product, process, or flow path.

Dynamic capacity constraints for stockpiles, processing plants, rail, port.

Satisfaction of contractual requirements for sales and logistics.

Size of material units that are added into a blend can be constrained to fit a specific raw tonnage in order to reflect truck size, train size, or vessel.

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

Automated material quality changes that model material transformation by time (e.g. oxidation) or volume (e.g. dozer push).

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

Logistic capacity constraints including truck, rail and conveyor can be setup by the user.

Option to define pre-processed and post-processed stockpiles.

Optimisation results within 5-10 minutes for most applications. Multiple optimisation scenarios can be executed simultaneously without impacting the runtime of each single optimisation execution.

Paradyn-Client Case Study | Selected Examples

CUSTOMER 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 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 Paradyn 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 Paradyn.

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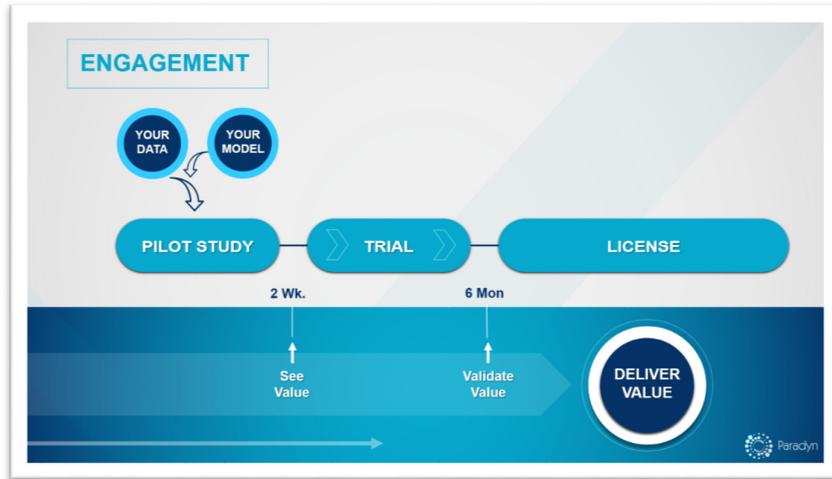
BlendOpt discovered a very different product strategy that reduced washing costs and improved revenue by $24M per year. With the exception of a small contract that needed to be delivered, BlendOpt entirely eliminated the premium product with almost all coal pushed into a higher yielding mid-ash product.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

Project Delivery Certainty

Paradyn has an impressive record of on-time and on-budget project performance and demonstrable business benefits for our clients. We are able to deliver these kinds of results by our continued investment in:

- Training and certifying our consultants in skills relevant to our clients' industries;
- Developing products and technologies specifically focused on our clients' business environment and ever-changing needs;
- Following our Implementation Methodology to bring clarity to the business challenges we help our clients to address;
- Defining the right scope, including thoughtfully crafted user controls for exerting influence over planning outcomes;
- Developing a project execution plan that enables early user testing with agile software development philosophies that allow our projects to adapt as requirements are clarified or redefined;
- Training on best practice methods for taking advantage of schedule optimisation systems including the analysis of complex scheduling data; and

- Expert advice on vision and strategy to ensure the system delivered is poised to offer benefits that extend beyond the project's immediate goals.

Customer Reference List