WARWICK BUSINESS SCHOOL
THE UNIVERSITY OF WARWICK

1. Masters Programmes: Assignment Cover Sheet

Student Numbers:	**5646570, 5656870, 5663496, 5645412, 5609225, 5580065**
Module Code:	**IB9EO0**
Module Title:	**Pricing Analytics**
Submission Deadline:	**10/03/2025**
Date Submitted:	
Word Count:	**1500**
Number of Pages:	**11**
Question Attempted: *(question number/title, or description of assignment)*	
Have you used Artificial Intelligence (AI) in any part of this assignment?	**No**

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1. Introduction

This report assesses the suitability of implementing a revenue-management strategy for BuildMax Rentals, a company specialising in heavy equipment rentals. By analysing BuildMax's business model, we identify the conditions necessary for effective RM and explore the unique challenges the company faces in applying these strategies. Additionally, we propose an optimisation model to maximise revenue, compare its performance against historical data, and discuss the potential return on investment (ROI). Finally, we outline a comprehensive RM implementation strategy, addressing key operational challenges and limitations to ensure sustainable revenue growth.

2. Conditions for Revenue Management

The first condition for RM is fixed capacity, as each BuildMax branch has a fixed inventory of heavy machinery, making capacity constraints a critical factor in pricing and allocation like hotel rooms and airline seats, where once equipment is fully rented out, missed revenue opportunities arise if demand exceeds supply.

The second factor is the perishability of resources and cost structure. While heavy machinery remains functional over time, idle equipment leads to lost revenue opportunities, much like an empty seat on a plane. However, BuildMax incurs higher costs for maintenance and servicing before equipment can be re-rented, making downtime a crucial factor in pricing decisions.

The third is variable demand, as fluctuations in rental needs create opportunities for dynamic pricing strategies. For instance, demand peaks in spring and summer for construction, while mining and oil companies typically require long-term leases, making demand highly cyclical and industry dependent. Airlines use surge pricing during peak travel periods, and BuildMax can adopt this approach by adjusting pricing based on seasonal demand trends.

The fourth condition is price-sensitivity and segmentation that plays a significant role in RM effectiveness. BuildMax serves a diverse customer base and just like car rental firms segment customers into leisure vs. business travelers, BuildMax can implement differentiated pricing models based on lease duration, urgency, and industry type.

Finally, BuildMax has low variable costs, meaning that the cost of renting out equipment does not significantly increase with each additional unit rented.

2.1. Challenges in applying RM to Buildmax

While BuildMax Rentals satisfies key conditions for revenue management, its operational characteristics introduce unique challenges that must be addressed.

Balancing Short vs. Long-Term Rentals

There is an inherent trade-off between short-term and long-term rentals. Accepting too many long-term leases improves fleet utilisation but reduces availability for higher-paying, short-term customers. Airlines face a similar challenge of deciding whether to sell seats early at lower prices or hold them for potential higher-paying customers. Similarly, hotels must balance business guests who book in advance at a discount against last-minute tourists who may be willing to pay a premium. This is why strategic capacity control and demand forecasting are vital.

Fleet Maintenance & Logistics

Unlike hotel rooms or airline seats that reset immediately after use, heavy machinery requires extensive servicing and repairs due to heavy usage. While leased cars are theoretically not heavily worn out, construction equipment endures intense usage. This introduces additional downtime costs that RM models must account for, and seasonal demand spikes may create bottlenecks in maintenance capacity, further complicating fleet utilisation strategies.

Branch Inventory & One-Way Rentals

BuildMax operates across multiple project sites, with customers often returning equipment to different branches. This is similar to car rental companies, where customers rent a car in one city and return it to another. However, while they often have efficient vehicle relocation strategies, heavy machinery transportation involves significant logistical costs and delays. Without an effective fleet rebalancing strategy, BuildMax could face inventory imbalances.

3. Proposed Linear Programming Model

Decision Variables:

$x_{i,j,o} =$ Number of equipment i rented in week j for duration o (Integer variable)

Where:

$i \in$ {Excavators, Cranes, Buldozers}

$j \in \{1, \dots, 52\}$

$o \in$ {1 week, 4 weeks, 8 weeks, 16 weeks}

$\mathrm{I}_{i,j} =$ amount of inventoty available for equipment i in week j (Integer variable)

Parameters:

$p_{i,o} =$ price per day for equipment i and duration o

$D_{i,j,o} =$ demand for equipment i in week j for duration o

Objective Function:

$$\max z = \sum_{i=1}^{3} \sum_{j=1}^{52} \sum_{o=1}^{4} (p_{i,o} * x_{i,j,o} * duration_o * 7)$$

Constraints:

Inventory capacity constraint:

$$\sum_{o=1}^{4} x_{i,j,o} \leq \mathrm{I}_{i,j} \ \forall i, \forall j$$

Inventory balance constraint:

Initial inventory for machine *i* in week *j*:

$$\mathrm{I}_{i,j} = \begin{cases} \text{Initial Inventory}_i, & if\ j = 0 \\ \mathrm{I}_{i,j-1} - \sum_{o=1}^{4} x_{i,j-1,o} + \sum_{o=1}^{4} x_{i,j-\,duration_o,o}\,, & if\ j \geq 1 \text{ and } \mathrm{j} - duration_o \geq 0 \end{cases}$$

Demand Constraint:

$$x_{i,j,o} \ \leq \ D_{i,j,o}\ \forall i, \forall j, \forall o$$

Non negativity constraints:

$$x_{i,j,o} \ \geq 0\ \forall i, \forall j, \forall o \text{ and Integer}$$

$$\mathrm{I}_{i,j} \geq 0\ \forall i, \forall j \text{ and Integer}$$

3.1. Analysis of the results

The optimisation model has significantly increased the total revenue by approximately 11.22%. Moreover, the model shows a positive revenue improvement across all equipment types, indicating that the model has successfully optimised their allocation, balancing short-term and long-term rentals to maximise revenue.

	TOTAL	EXCAVATORS	CRANES	BULLDOZERS
Optimised Revenue	178,478,636	49,866,264	69,471,738	59,140,634
Historical Revenue	160,473,614	45,274,005	61,785,689	53,413,920
Difference	18,005,022 (11.22%)	4,592,259 (10.14%)	7,686,049 (12.44%)	5,726,714 (10.72%)

Return on Investment

To analyse the change in ROI, we start defining ROI as:

$$\text{ROI} = \frac{\text{Revenue} - \text{Total Cost}}{\text{Total Cost}} \text{ x } 100$$

Cost per machine and initial stock:

Equipment	Cost per Machine (£)	Initial Stock	Total Cost (£)
Excavators	12,000	760	9,120,000
Cranes	15,000	830	12,450,000
Bulldozers	25,000	900	22,500,000
Total	-	-	44,070,000

$$\text{ROI}_{\text{Historical}} = \frac{160.473.614 - 44.070.000}{44.070.000} \text{ x } 100 = 264.1\ \%$$

$$\text{ROI}_{\text{Optimised}} = \frac{178.478.636 - 44.070.000}{44.070.000} \text{ x } 100 = 304.9\ \%$$

The optimised revenue model resulted in an increase of 15.45% in the ROI. This indicates that the revenue optimisation strategies have successfully increased profitability without additional equipment investment.

3.2. Insights and Implications

The overall revenue-growth of 11.22% demonstrates the positive impact of implementing an RM strategy at BuildMax. Such an improvement could significantly enhance profitability, particularly in a capital-heavy industry like heavy equipment rentals.

The optimisation model has driven notable revenue increases across various equipment types:

- Excavators: 10.14%
- Cranes: 12.44%
- Bulldozers: 10.72%

These improvements highlight the model's success in optimising the allocation and pricing strategies for each equipment type. Overall, the improved revenue suggests that BuildMax could get a better ROI (15.45%) by using the RM strategy proposed.

4. Implementation of RM Strategy

RMS in any organization would require a specific approach to balance out pricing of the products, their inventory and customer demand. The historical rental data shared with us would be examined through ML-models to forecast the demand for BuildMax's equipment over the lease durations from 1-16 weeks. This would allow it to adjust their prices and accordingly plan maintenance schedules of their inventory. High demand of projects in the months of summer and spring could be more accurately estimated. However, it would not take several factors into consideration like economic conditions, competitor-pricing, maintenance-completion schedule.

Equipment rates should be adapted to real-time demand and inventory levels to maximise revenue. Furthermore, discounts could be offered for bulk corporate bookings to attract high-volume clients while maintaining profitability.

A centralised Inventory Management System (IMS) integrated with demand forecasting would allow BuildMax to strategically allocate equipment across branches based on expected demand and utilisation rates to avoid instances of overstocking at low-demand locations while preventing stockouts at high-demand branches, ensuring that the right equipment is available at the right time to meet demand while maximising fleet utilisation.

A dynamic booking system would optimise the efficiency of both direct channels (branch offices and online bookings) and indirect channels (3rd party rental platforms) by providing real-time availability and pricing information to improve customer experience and conversion rates. Furthermore, integrating them with the IMS would allow BuildMax to apply consistent pricing strategies across all platforms while dynamically adjusting rates based on demand and availability.

Since BuildMax serves various industries, each with its unique needs and price sensitivities, pricing strategies would be tailored to different customers based on their industry, project duration, and rental volume. Long-term rentals with flexible return policies would be marketed to mining and oil companies, while premium pricing to short-term, high-demand rentals for construction-projects, allowing for personalised marketing campaigns to increase customer-loyalty and retention.

5. Limitations of the model

The current model excludes the maintenance-time before renting equipment out again, which impacts fleet availability. Ignoring this aspect would lead to an overestimation of equipment availability and unrealistic rental schedules. This can be resolved by adding constraints that account for the time required to service equipment after each rental.

Additionally, one-way rentals are not considered where equipment is returned to a different location, creating logistical challenges such as the need to transport equipment back to its original branch or other branches. Thus, leading to suboptimal fleet allocation and increased transportation costs. Time delays and logistic costs could be incorporated into the model to avoid this issue by adding constraints for tracking the location of equipment to account for the time required to move it between branches and optimise its redistribution.

The model also assumes that customer behavior is consistent and predictable. However, it may change over time affecting demand, so it should be consistently updated with the latest data by incorporating feedback from customers and branch managers, ensuring that the model remains relevant and effective in capturing changing customer trends.

Lastly, implementing and integrating the model across multiple branches with unique existing systems might be challenging. BuildMax should adopt a phased implementation approach, starting with a pilot branch and gradually rolling out the model to other ones. This will allow the company to identify and address any issues before full-scale implementation.

6. Conclusion

The analysis presented in this report demonstrates that BuildMax Rentals is well-positioned to benefit from the implementation of an RM strategy. The optimisation model has shown a significant revenue increase of 11.22% compared to historical data, with notable improvements across all equipment types. This translates to a 15.45% increase in the ROI, highlighting the potential for increased profitability without additional capital investment. However, the model also reveals areas for further refinement, such as accounting for equipment maintenance, one-way rentals, and evolving customer behavior.

To successfully implement RM, BuildMax should adopt a phased approach, starting with a pilot branch and gradually expanding to others. Key components of the strategy include dynamic pricing, centralised inventory management, and demand forecasting integrated with real-time data analytics. While the proposed model offers a strong foundation, ongoing adjustments and updates will be essential to maintain its effectiveness in a dynamic market environment.