WARWICK BUSINESS SCHOOL
THE UNIVERSITY OF WARWICK

Masters Programme: Group Assignment Cover Sheet

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Question: *(question number/title, or description of assignment)*	**The proposal for BuildMax should explain the RM strategy, focusing on its benefits for optimizing revenue and fleet utilization. It should address challenges like data accuracy and demand fluctuations, evaluate potential drawbacks, and suggest solutions, within a 1500-word technical report.**
Have you used Artificial Intelligence (AI) in any part of this assignment?	**No**

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In submitting my work, I confirm that:

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- I declare that this work is being submitted on behalf of my group and is all our own, except where I have stated otherwise.
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- I understand that should this piece of work raise concerns requiring investigation in relation to any of points above, it is possible that other work I have submitted for assessment will be checked, even if marks (provisional or confirmed) have been published.
- Where a proof-reader, paid or unpaid was used, I confirm that the proof-reader was made aware of and has complied with the University's proofreading policy.

Upon electronic submission of your assessment you will be required to agree to the statements above

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Question 1

1.1. Suitability of Revenue Management for BuildMax Rentals

Revenue Management (RM) suits BuildMax Rentals well as it meets key criteria. The company has a fixed-capacity fleet, so RM helps avoid idle equipment or shortages during peak demand. Rental equipment is perishable, making dynamic pricing for optimal rental periods necessary.

BuildMax has low variable costs, but maintenance and logistics are complex. With demand fluctuating seasonally and by industry, RM adjusts pricing. Serving diverse customers, from fixed-budget government projects to discount - seeking corporate clients, RM balances pricing for maximum revenue and customer satisfaction.

Hence, RM is essential for maximizing fleet utilisation and revenue.

1.2. Key Advantages of Revenue Management (RM)

a) Seasonal Demand Optimisation: Dynamic pricing maximises revenue during peak seasons and minimises losses in off-peak periods through precise demand forecasting.
b) Balancing Rentals: RM balances long-term contracts with high-margin short-term rentals, ensuring revenue stability and optimised fleet availability.
c) Fixed Budget Management: RM enables competitive pricing for government contracts with fixed budgets while maintaining profitability.
d) Fleet Utilisation: Efficient allocation reduces underutilisation during low demand and prevents shortages during peak demand.
e) Dynamic Pricing Flexibility: RM adjusts rates based on market conditions, maximising revenue per unit and ensuring optimal fleet availability.

1.3. Key Challenges of Revenue Management

a) Corporate Discounts: Offering bulk pricing for corporate clients increases rental volume but reduces revenue per transaction, requiring a delicate balance to ensure long-term profitability.

b) Logistics: One-way rentals introduce operational challenges, increasing redistribution costs and complicating fleet management, necessitating efficient planning to optimise fleet distribution.

c) Maintenance Downtime: Equipment servicing affects fleet availability, requiring advanced fleet management strategies to minimise revenue loss during maintenance and ensure optimal rental uptime.

1.4. Comparison with RM in Airlines, Car Rentals, and Hotels

BuildMax Rentals faces challenges similar to airlines, car rentals, and hotels, particularly in fixed capacity, perishable inventory, pricing strategies, demand fluctuations, and logistics complexity. Unrented fleet units mean lost revenue, so inventory management is key. Seasonal demand requires dynamic pricing, and customer segmentation for targeted pricing, similar to differentiating business and leisure travellers. Fleet and logistics management is crucial for balancing rentals. Data - driven strategies can boost utilization, revenue, and competitiveness, ensuring BuildMax's long - term profitability *(Appendix A).*

Question 2

The optimisation problem is structured as a constrained revenue maximisation problem, ensuring that equipment rentals remain within inventory and demand limits.

2.1. Decision Variables

The model defines the decision variable $x_{[i,j,t]}$ as the number of rentals for equipment type j with lease duration i in time period t, where:

i: lease duration (1 for 1-week lease, 2 for 4-week lease, 3 for 8-week lease, 4 for 16-week lease)

j: equipment types (1 for Excavators, 2 for Cranes, 3 for Bulldozers)

t: time period, $t = 1, \cdots, 52$ weeks

x_{ijt}: the number of equipment j leased for duration i in time period t

2.2. Objective Function

The objective function maximises total revenue by optimising rental allocations across all equipment types and lease durations:

$$\max Z = \sum_{i=1}^{4} \sum_{j=1}^{3} \sum_{t=1}^{52} P_{ijt} \times x_{ijt} \times T_i$$

Where:

P_{ijt}: daily rental price of equipment j with lease duration i in time period t

x_{ijt}: the number of equipment j leased for duration i in time period t

T_i: the number of days corresponding to lease duration i (T_1=7, T_2=28, T_3=56, T_4=112)

2.3. Constraints

To ensure a feasible rental allocation, the following constraints were implemented.

1) Inventory Constraint

Ensures that at any time t, the total number of leased units cannot exceed the available inventory.

$$\sum_{i=1}^{4} x_{ijt} \leq I_{jt}, \forall j \in \{1,2,3\}, \forall t \in \{1, \dots, 52\}$$

Where I_{jt}: the inventory quantity of equipment j in time t

2) Demand Constraint

The number of rented units should not exceed market demand.

$$x_{ijt} \leq D_{ijt}, \forall i \in \{1,2,3,4\}, \forall j \in \{1,2,3\}, \forall t \in \{1, \dots, 52\}$$

Where D_{ijt} is the predicted demand for equipment j, lease type i, in week t

3) Inventory Update Constraint

Inventory of equipment depends on the previous week's inventory and returned equipment.

a) **Initial Inventory Constraint** (for first week $t = 1$):

$$I_{j1} = S_j, \forall j \in \{1,2,3\}$$

Where S_j is the starting inventory for equipment j

b) **Dynamic Inventory Update** (for $t > 1$)

$$I_{j,t} = I_{j,t-1} + \sum_{i}^{4} x_{i,j,t-W_i} - \sum_{i}^{4} x_{i,j,t-1}, \forall j \in \{1,2,3\}, \forall t \in \{1, \dots, 52\}, t > 1$$

Where:

W_i: the number of weeks corresponding to lease duration i (W_1 = 1, W_2 = 4, W_3 = 8, W_4 = 16).

$x_{i,j,t-Wi}$ represents equipment that was rented W_i weeks ago and is now returned.

If $t - W_i < 1$, then assume $x_{i,j,t-W_i} = 0$.

4) **Non-Negativity and Integer Constraints**:

Ensures lease quantities x_{ijt} are non-negative integers

$$x_{ijt} \geq 0, x_{ijt} \in Z, \forall i \in \{1,2,3,4\}, \forall j \in \{1,2,3\}, \forall t \in \{1, \dots, 52\}$$

The model was implemented in Pyomo and solved using the GLPK solver, with demand, inventory, and price data extracted from the provided dataset.

2.4. Revenue and ROI Improvements through Optimisation

The linear programming optimisation model led to significant improvements in both revenue and operational efficiency for BuildMax Rentals. This analysis compares the optimised results against the actual revenue, highlights lost revenue due to unfulfilled demand, and evaluates key performance metrics, including ROI, fleet utilisation, and overall revenue performance.

2.4.1. Revenue Optimisation Impact by Equipment Type (£)

The optimisation resulted in a total revenue increase of £18M (+11.22%), with cranes showing the highest revenue improvement.

The optimised revenue resulted in substantial improvements across all equipment types. Cranes saw the highest increase in revenue at £7.69M, followed by bulldozers (£5.73M) and excavators (£4.59M). *(Appendix B)*

2.4.2. Fleet Utilisation and ROI Impact

The optimisation process led to a significant improvement in return on investment (ROI) across all equipment categories, with the overall ROI increasing by 15.47%. Excavators saw a substantial rise in utilisation, from 51.30% to 79.99%, contributing to a 12.70% ROI improvement. Cranes followed with a notable increase in utilisation, from 41.34% to 68.95%, resulting in a 15.58% ROI boost. Bulldozers, while exhibiting a more moderate increase in utilisation from 34.97% to 49.85%, experienced the most substantial ROI enhancement of 18.52%, further solidifying their strong financial performance within the rental market. These findings underscore the effectiveness of a data-driven inventory allocation strategy in maximising fleet utilisation and profitability *(Appendices C and D).*

2.4.3. Insights and Differences Between Equipment Types

Unused inventory loss totals £1.68B (excavators £377.9M, cranes £586M, bulldozers £718.6M), while rejected rental losses hit £3.03M (excavators £1.54M, cranes £1.04M, bulldozers £447K), reflecting significant missed revenue opportunities *(Appendix E)*.

These losses highlight the potential for revenue gains through fleet expansion and better availability.

2.4.4. Overall Revenue Performance

As shown in Table 1, the optimised rental revenue achieved was £178.48M, compared to the actual rental revenue of £160.47M, resulting in a revenue improvement of £18.01M (+11.22%). The overall ROI improved by 15.47%, from 264.13% to 304.99% *(Appendix F).*

Metric	***Actual***	***Optimised***	***Improvement***
Revenue	£160,473,614	£178,478,636	£18,005,022
ROI	264.13%	304.99%	15.47%

Table 1: Revenue and ROI Comparison

2.5. Potential for Implementing a Revenue Management Solution

The findings indicate that implementing a Revenue Management solution at BuildMax offers a major revenue - enhancement opportunity via optimized inventory allocation. By strategically reallocating equipment availability, the proposed approach effectively maximises fleet utilisation, minimises idle time, and prioritises the allocation of equipment to the most profitable rental requests. The observed revenue increase in our optimization underscores the critical role of data-driven inventory management, demonstrating that even without modifying rental prices, BuildMax can significantly improve profitability by systematically adjusting the acceptance and rejection of rental requests. These results provide strong evidence for the adoption of a structured RM framework, which would enable more informed decision-making, enhance operational efficiency, and drive sustainable long-term revenue growth.

Question 3

3.1. Implementation of Revenue Management Strategy

To effectively implement the proposed revenue management strategy, BuildMax can adopt the following measures:

1. Dynamic Pricing and Demand Forecasting: Utilise advanced predictive analytics to optimize pricing in real-time, adjusting rental rates based on seasonal demand fluctuations. Peak season pricing maximizes revenue, while off-peak discounts enhance fleet utilisation.
2. Long-Term Lease Optimisation: Implement flexible return policies and duration-based pricing for mining and oil sector clients to balance long-term commitments with short-term revenue opportunities.
3. Fixed Pricing for Government Contracts: Establish stable pricing structures for government projects to align with budget constraints, ensuring transparency and predictable revenue.
4. Fleet and Inventory Optimisation: Deploy real-time tracking systems to enhance fleet utilisation, balancing short-term and long-term rentals.
5. Competitive Pricing and Bulk Discounts: Automate pricing adjustments based on market trends and competitor rates while offering structured bulk discounts for corporate clients.

These strategies will enhance revenue optimisation and operational efficiency across rental categories.

3.2. Limitations and Improvements

The proposed revenue management strategy has limitations that BuildMax must address to maximise effectiveness. The model assumes fixed demand, overlooking seasonal shifts and economic changes, which may cause fleet misallocation. Integrating real-time demand forecasting will enable dynamic adjustments, improving fleet utilisation and revenue efficiency. It also assumes full fleet availability, ignoring maintenance delays and operational constraints. Predictive maintenance systems will ensure availability aligns with rental demand and operational needs.

Relying on fixed pricing limits revenue potential during peak periods. Implementing dynamic pricing based on market trends will optimise revenue. The model does not prioritise high-value clients; customer segmentation will improve profitability and retention. Additionally, it overlooks logistical constraints, such as fleet movements and one-way rentals, increasing costs. Logistics optimisation will improve operations and resource allocation.

Addressing these limitations will refine BuildMax’s revenue management strategy, enhancing profitability, efficiency, and long-term growth.

4. Appendices

4.1. Appendix A: Comparison with RM in Airlines, Car Rentals, and Hotels

FACTOR	BUILDMAX RENTALS	AIRLINES	CAR RENTALS	HOTELS
Fixed capacity	Limited equipment at each branch.	Limited seats per flight.	Limited feet per location.	Limited rooms per hotel.
Perishable inventory	Idle equipment leads to lost revenue.	Unsold seats cannot be recovered.	Unrented vehicles generate no revenue.	Empty hotel rooms result in lost revenue.
Pricing strategy	Seasonal (construction peaks in spring/summer)	High variation due to seasons holidays and events.	Demand varies by season and location.	Peak and off-peak periods (holidays, events, weekdays)
Customer Segmentation	Dynamic pricing based on demand, competition, and inventory.	Dynamic pricing by demand, booking time, and season.	Dynamic pricing based on location, demand, and fleet size.	Rates change based on season , occupancy, and booking time.
Demand Fluctuation	Contractors, government, corporate, clients.	Business, leisure travellers, students.	Business vs. leisure customers.	Business vs. vacation travellers.
Logistics Complexity	Equipment must be serviced, moved and maintained.	Flight scheduling, overbooking risks.	Managing fleet distribution and one-way rentals.	Housekeeping and room maintenance
Long vs. short-term Rentals	Balancing short-term vs. long-term contracts.	Short-haul vs. long-haul flights.	Daily vs. long-term car rentals.	Nightly stays vs. extended stays.

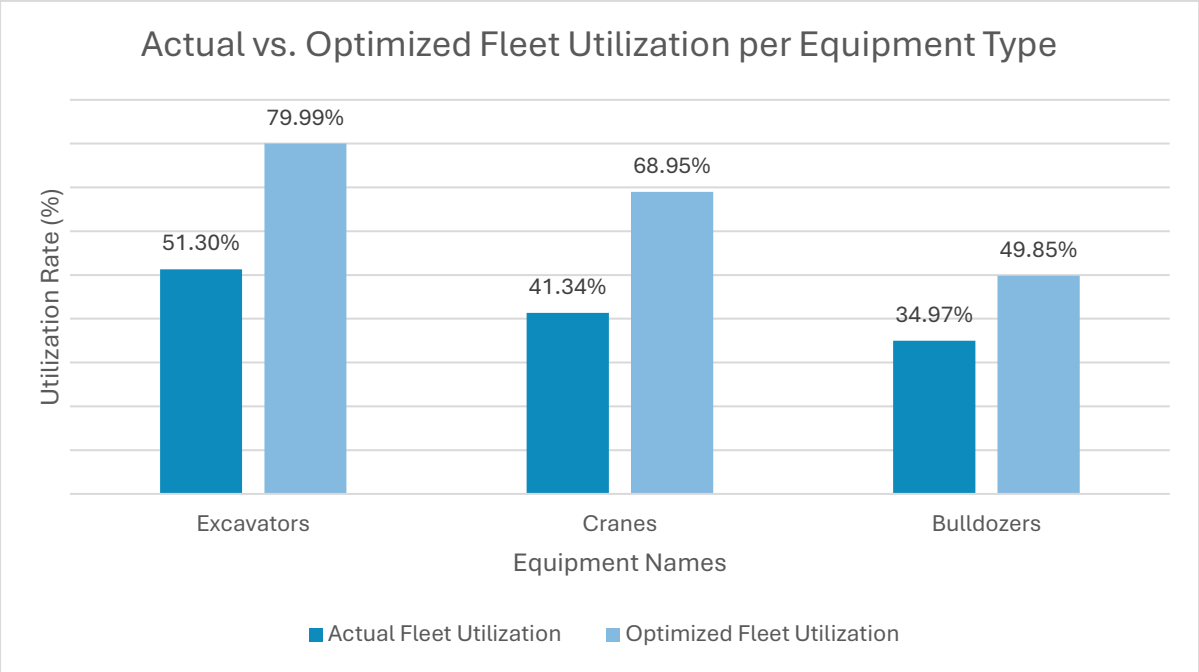
4.2. Appendix B: Revenue Optimisation Impact By Equipment Type

Equipment	***Optimized revenue (£)***	***Revenue improvement (£)***	***Revenue improvement rate (%)***
Excavators	£49,866,264	£4,592,259	10.14%
Cranes	£69,471,738	£7,686,049	12.44%
Bulldozers	£59,140,634	£5,726,714	10.72%

4.3. Appendix C: Fleet Optimisation and ROI Impact By Equipment Type

Equipment type	*Original utilization rate (%)*	*Optimized utilization rate (%)*	*Improved utilization rate (%)*	*Actual ROI (%)*	*Optimized ROI (%)*	*ROI improvement (%)*
Excavators	51.30%	79.99%	55.91%	396.43%	446.78%	12.70%
Cranes	41.34%	68.95%	66.79%	396.27%	458.01%	15.58%
Bulldozers	34.97%	49.85%	42.58%	137.40%	162.85%	18.52%

4.4. Appendix D: Fleet Utilisation Comparison By Equipment Type (Actual vs Optimised)



4.5. Appendix E: Unused Inventory and Rejected Rentals Revenue Loss By Equipment Type

Equipment type	***Unused inventory revenue loss (£)***	***Rejected rentals revenue loss (£)***
Excavators	£377,948,928	£1,546,769
Cranes	£586,067,293	£1,040,970
Bulldozers	£718,611,964	£447,146

4.6. Appendix F: Overall Revenue Comparison (Actual vs Optimised)