XN GROUP PROJECT

Group 10:

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ALY6080.90325: Integrated Experiential Learning

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CONTENT

INTRODUCTION

EXECUTIVE SUMMARY

The goal of the XN project is to help the Simplex Solution company optimize equipment utilization and reduce costs by analyzing the datasets using Power BI. For this, we have the following business question, "Do all using equipment actually being utilized?". Most of the equipment are rented, while others are owned. The rent payment depends not on the time the equipment is being turned on (utilization time) but on the total working hours of the crew (billing hours). Therefore, visualizing data using Power BI would help discover inefficiency as well as finding possible explanations for that. This will allow the sponsor's clients to analyze data deeper and make better decision to optimize equipment utilization.

DATASETS

There are three Excel files the sponsor provided for the analysis:
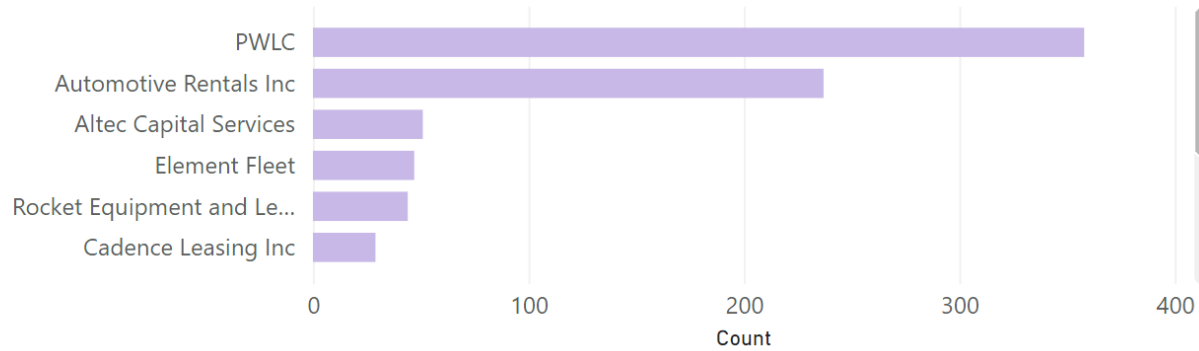
1. *"Equipment Master List 2022-05-31.xlsx"* – the main file that contains details about equipment

2. *"Equipment Billing 2022-05-31.xlsx"* – contains info about hours equipment has been occupied and will be billed

3. *"Equipment Utilization 2022-05-31.xlsx"* - contains info about equipment utilization time when it has been turned on
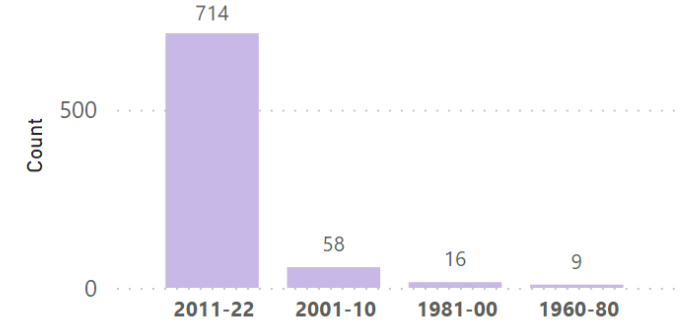
EXPLORATORY DATA ANALYSIS

Dashboard 1: Master List

Top 10 Owners

- PWLC
- Automotive Rentals Inc
- Altec Capital Services
- Element Fleet
- Rocket Equipment and Le...
- Cadence Leasing Inc

Count: 0, 100, 200, 300, 400

801
of Total Equipment

Model Year

2011-22	2001-10	1981-00	1960-80
714	58	16	9

Financing Method

- 33 (4.12%)
- 393 (49.06%)
- 375 (46.82%)

Type
- O
- L
- R
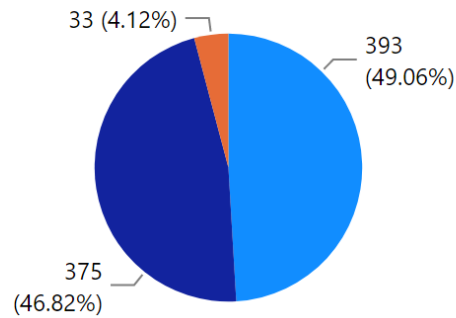
Top 10 Equipment w Highest Avg Monthly Rent

- RETC378
- TC348
- TC349
- TC294

Avg Monthly Pmt: 0K, 5K
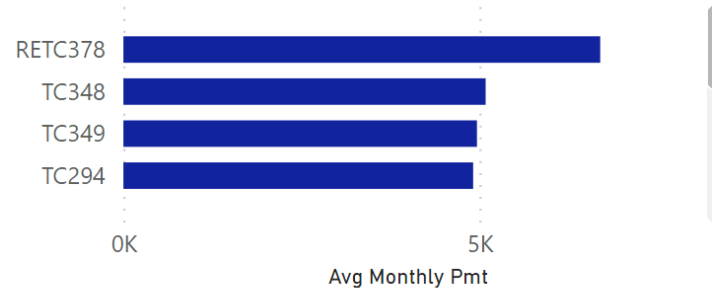
Top 5 Description for Equipment w Monthly Pmt

- 3/4T Pickup Truck
- 1/2T Pickup Truck
- 47' Sh Ht Digger Der...
- 2T Flatbed Truck
- 60' Wk Ht Bucket Tru...

Count: 0, 50, 100

Average Monthly Lease

1.32K

0.00 — 2,641.21

Monthly Lease Payment

- 373 (46.57%)
- 428 (53.43%)

- No
- Yes
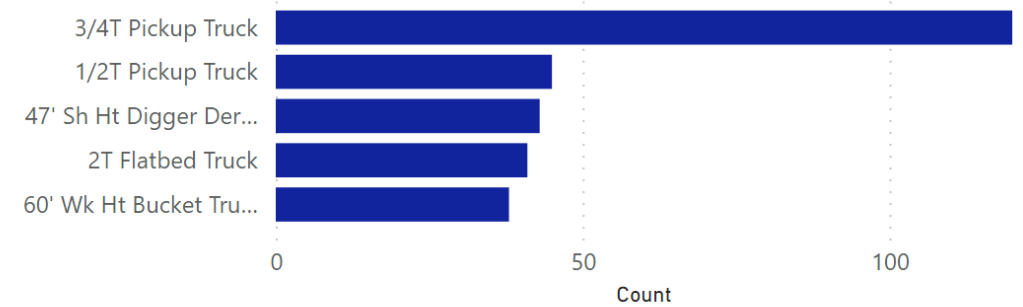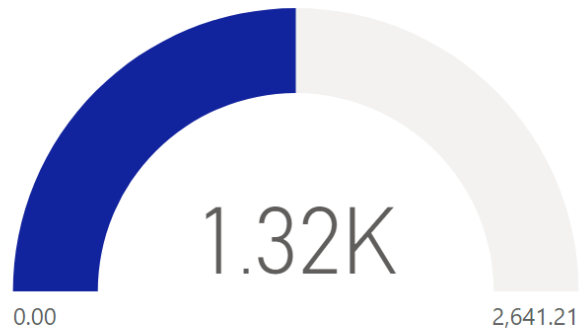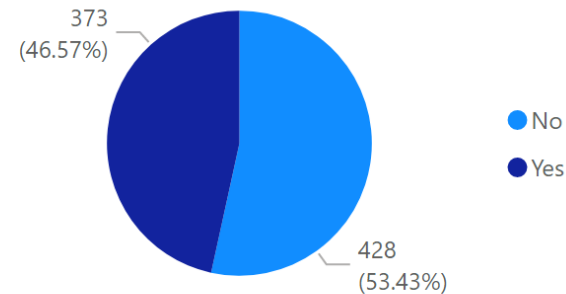
Top 5 Description for Equipment w/o Monthly Pmt

- Pole Trailer
- 1/2T Pickup Truck
- 60' Wk Ht Bucket Tru...
- 500 Gallon Water Tra...
- 2T Flatbed Truck

Count: 0, 20, 40

1. ANALYSIS
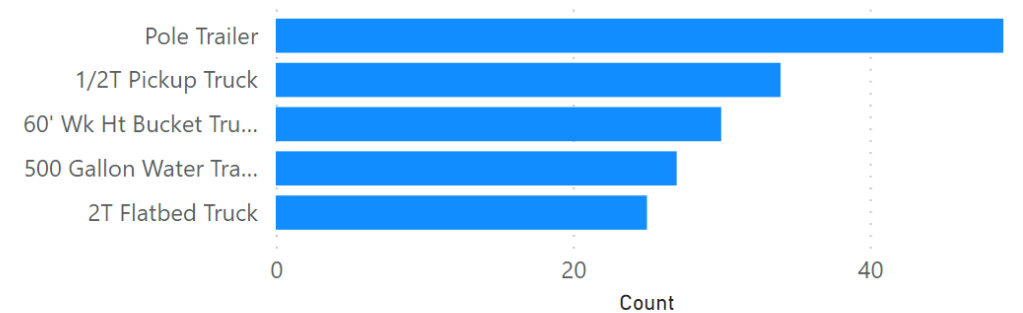
- **714** out of 801 total equipment models are new and belong to PWLC company.

- **53.43%** of the them have monthly lease payment, and the average cost is **$1,320**

- The top equipment with the highest average monthly payment is **RETC378**

- **49.06%** of them are owned, while the rest are rented

- The 3 most popular types of equipment are:
  - **1/2T Pickup Truck**
  - **2T Flatbed Truck**
  - **60' Wk Ht Bucket Truck**

Dashboard 2: Equipment Billing

Count of Billing Hours

11691 (10.68%)

Type
- >0
- 0

97766
(89.32%)
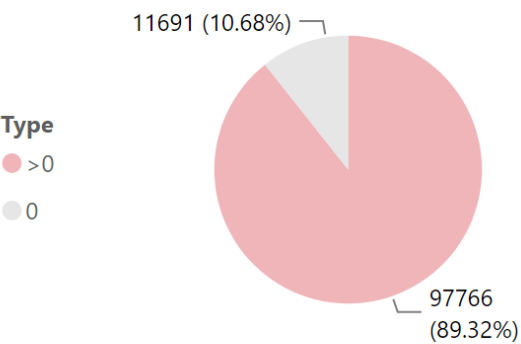
Records of Billable Hours by Month

Type ● >0 ● 0

Month	>0	0
January	6231	317
February	6932	411
March	8735	446
April	7556	398
May	12253	1545
June	6163	1461
July	5569	770
August	7473	558
September	6180	262
October	6580	481
November	5039	425
December	4463	414

Count (Y axis: 0K, 10K)
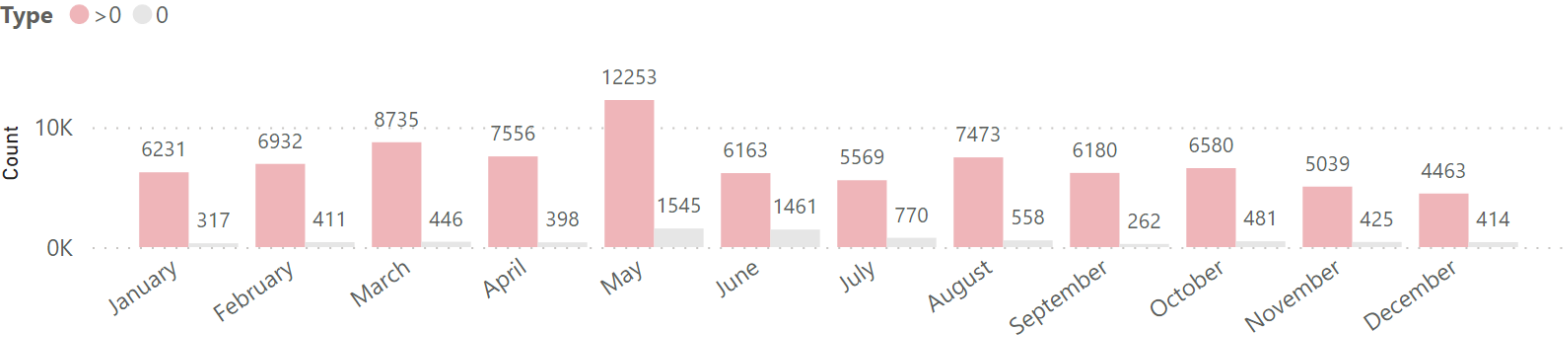
Distribution of Hours Greater than 0

Count (Y axis: 0K, 2K, 4K, 6K, 8K)

X axis: 10, 8, 12, 6, 4, 14, 13, 5, 11, 7, 16, 2, 15, 3, 9, 18, 12.5, 13.5, 14.5, 17, 11.5, 10.5, 1, 5.5

Monthly Lease Pymt ● No ● Yes
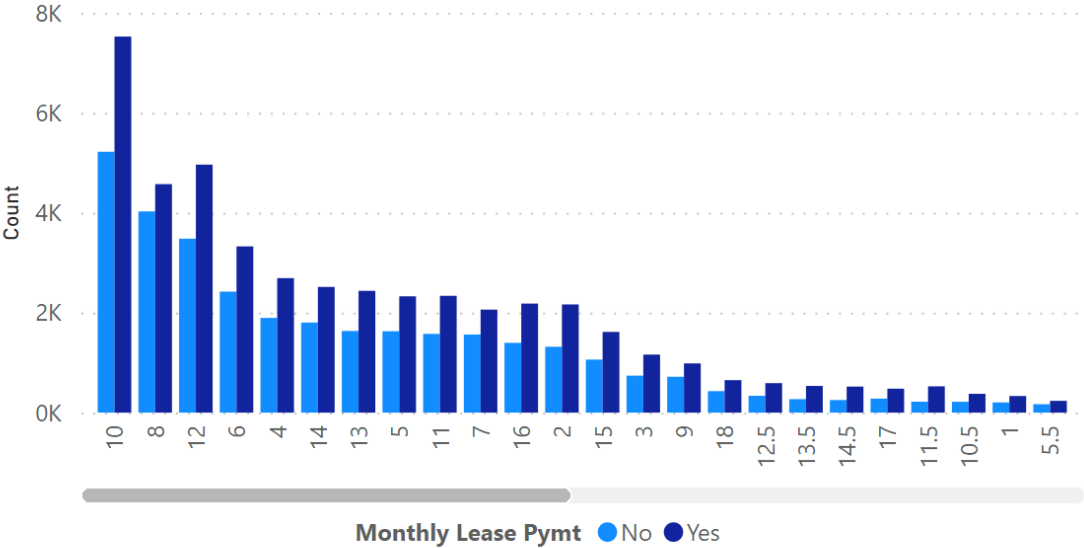
Distribution of 0 and Null Hours

	0	NULL
No	4454	129
Yes	2744	161

Count (Y axis: 0K, 2K, 4K)

Monthly Lease Pymt ● No ● Yes

2. ANALYSIS
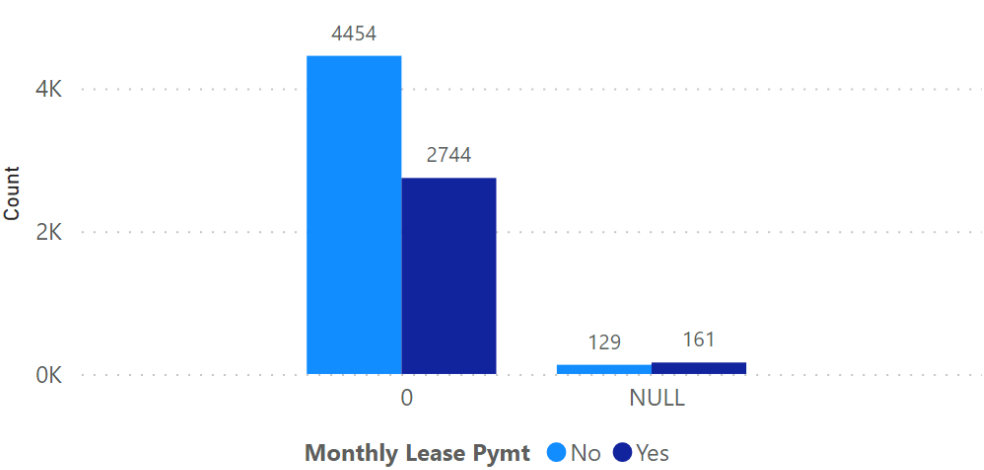
- **89.32%** of the equipment have **> 0** billable hours, and only **10.68% 0** billable hours. This means that most of the equipment were occupied whether they were used or not

- Among all months, **May** has most frequent billable hours entries of **12,253** records

- Most of equipment are billed for **10, 8, and 12** hours of usage, the one with monthly lease payment prevails having **over 5,000** records

- There are **more than 7,000** records of the equipment with **0** billing hours where most of them do not have a monthly lease payment

Dashboard 3: Equipment Utilization

Count of Utilization Time

116173 (37.28%)

195450 (62.72%)

Type
- ⬤ 0 hh:mm:ss
- ⬤ >0 hh:mm:ss
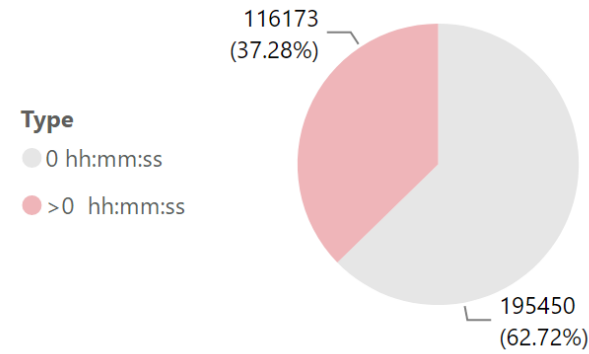
Records of Utilization Time by Month

Type ⬤ >0 hh:mm:ss ⬤ 0 hh:mm:ss

Month	>0	0
January	9967	15580
February	9562	13500
March	10697	15189
April	8534	13934
May	11771	19014
June	10256	15272
July	9360	17367
August	9924	16862
September	8741	16393
October	10133	17111
November	8842	17445
December	8386	17783

Count (Y-axis: 0K, 10K, 20K)

Distribution of Utilization Time Greater than 0

X-axis categories: 00:00:01 - 01:0..., 01:00:01 - 02:00:00, 02:00:01 - 03:00:00, 03:00:01 - 04:00:00, 04:00:01 - 05:00:00, 05:00:01 - 06:00:00, 06:00:01 - 07:00:00, 07:00:01 - 08:00:00, 08:00:01 - 09:00:00, 09:00:01 - 10:00:00, 10:00:01 - 11:00:00, 11:00:01 - 12:00:00, 12:00:01 - 13:00:00, 13:00:01 - 14:00:00, 16:00:01 - 17:00:00, 15:00:01 - 16:00:00, 14:00:01 - 15:00:00, 22:00:01 - 23:00:00, 21:00:01 - 22:00:00, 17:00:01 - 18:00:00, 18:00:01 - 19:00:00, 20:00:01 - 21:00:00, 23:00:01 - 23:59:59, 19:00:01 - 20:00:00

Count (Y-axis: 0K, 5K, 10K)

Monthly Lease Pymt ⬤ No ⬤ Yes

Distribution of 0 Utilization Time

93522

58304

Count (Y-axis: 0K, 50K, 100K)

00:00:00

Monthly Lease Pymt ⬤ No ⬤ Yes
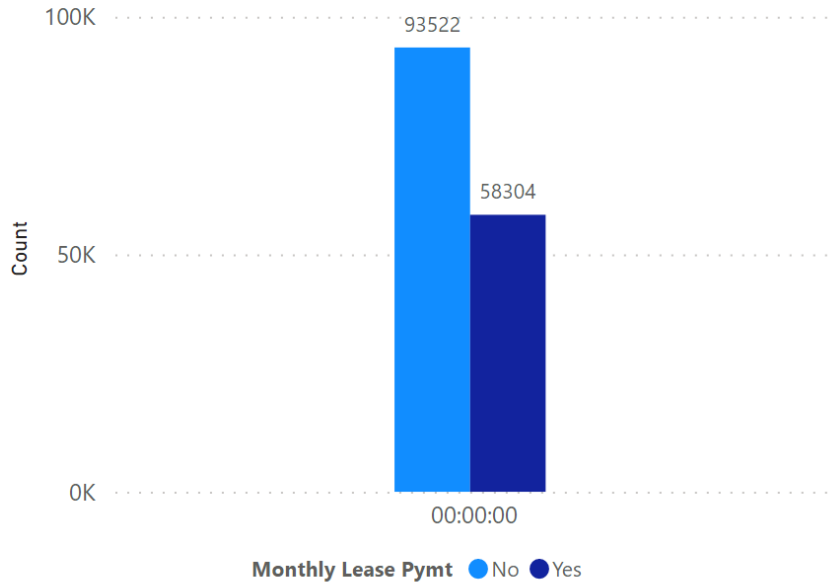
3. ANALYSIS

- **62.72%** of the equipment have 0 utilization time, and only **37.28%** have **>0** utilization time. This means that most of the equipment were not turned on thus were not actually used but occupied having idle time

- Almost all months have equal count of utilization time records

- **Over 10,000** records consist the utilization time of **between 1 sec to 1 hours**. This means that they were used for short period of time only. Equipment with no monthly lease payment are prevailing

- There are more than **150,000** records of the equipment with **0** utilization time where most of them do not have monthly lease payment
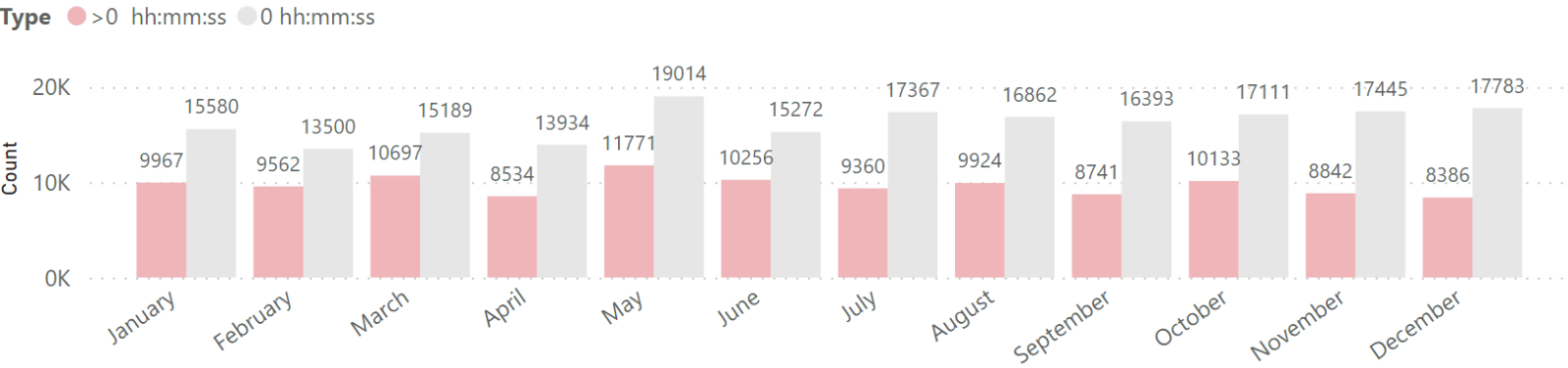
DATA INTEGRATION
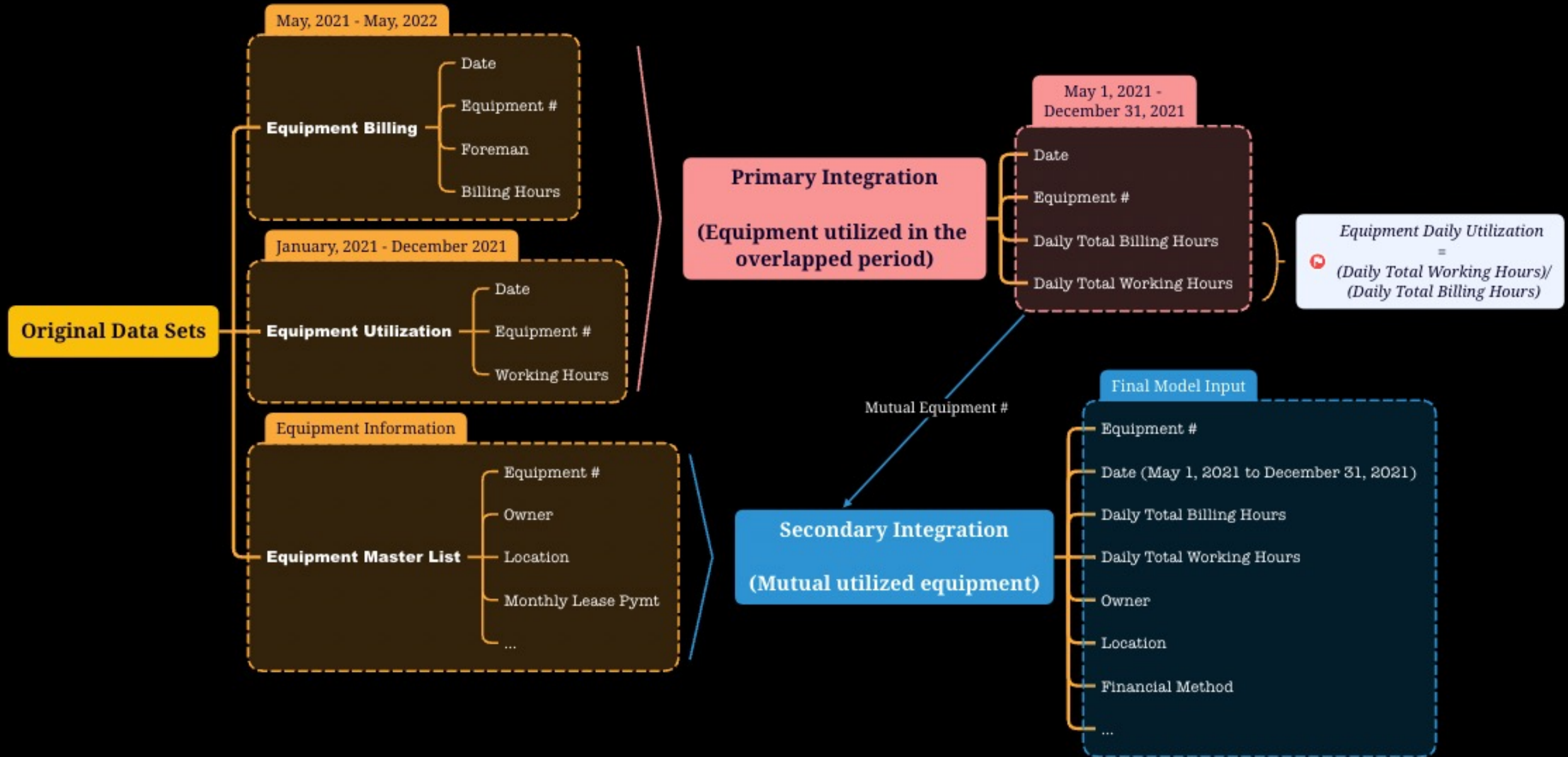
UTILIZATION ANALYSIS

Overall Utilization Performance
May 2021 - December 2021

Distribution of Total Working Hours & Total Billing Hours

● Total Working Hours ● Total Billing Hours

Distribution of Overall Utilization (%)

Date

Proportion of Financing Methods

Rented
Owned
Leased
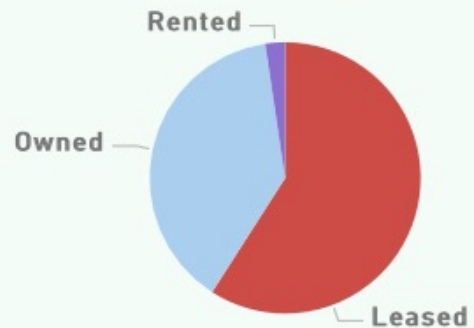
Utilization Group by Project Locations

Location	Ttl Working Hours	Ttl Billing Hours	EQT Utilization (%)
SSE: Sourcing Saint Jordan	40,813.78	100,358.50	40.67
Medford	33,112.93	95,109.90	34.82
SSE: Trog Von Sale	25,965.63	88,903.00	29.21
SSE: Sourcing Countryside	34,706.38	81,896.90	42.38
SSE: VE Gem Red	28,888.43	61,496.00	46.98
SSE: Mot Oven	10,359.37	31,657.00	32.72
San - Mateo	12,501.05	26,221.00	47.68
San - Mateo	7,400.47	22,070.50	33.53
SSE: Sourcing Red	2,747.40	10,384.50	26.46

Average Utilization Group by Foremen

Foreman	AVG Working Hours	AVG Billing Hours	EQT Utilization (%)
Liam Johnson	0.47	11.44	4.10
Oliver Green	0.86	9.28	9.24
James William	0.95	10.00	9.54
Eric Noah	1.20	10.96	10.91
Benjamin Brook	1.44	12.38	11.64
Lucas Ortega	0.50	4.00	12.60
Robert James	1.43	10.26	13.91
Michael Jeff	1.15	8.00	14.35
George Adam	2.57	12.00	21.38

DASHBOARD FUNCTIONS:

- Time series of total working hours and total billing hours, along with the equipment utilization, enable users to evaluate the rental equipment performance in the past periods

- The interactive visualization enables users to separately check the time series and tables containing the exact utilization performance of different types of equipment

Individual Equipment Utilization Performance
May 2021 to December 2021

Project Filter

Construction Locations

- ☐ Select all
- ☐ (Blank)
- ☐ South Washington
- ☐ New England
- ☐ Roxbury
- ☐ Brookline
- ☐ Beacon Hill
- ☐ Charlestown
- ☐ Cambridge
- ☐ Santa Barbara

Date Filter

Year, Quarter, Month, Day

- ◪ Select all
- ☐ (Blank)
- ▲ ◪ 2021
  - ∨ ☐ Qtr 1
  - ∨ ☐ Qtr 2
  - ▲ ◪ Qtr 3
    - ∨ ☐ July
    - ∨ ☐ August
    - ▲ ■ September

Distribution of Total Working Hours and Total Billing Hours

Financing Methods ▲ Leased ▲ Owned ▲ Rented

Equipment with Utilization Less than 10%

Equipment	Ttl Working Hours	Ttl Billing Hours	Utilization (%)	Foreman
TLR1655	0.00	335.00	0.00	Garry Wing
WS067	0.00	335.00	0.00	Garry Wing
WT127	0.00	316.00	0.00	Sam Jack
WS273	0.00	307.00	0.00	Daniel Gill
DD835	0.00	248.00	0.00	Gabriel Noah
TLR2008	22.20	235.50	9.43	Arnold Adams
TLR760	0.00	222.50	0.00	Bernard Kim
TLR2152	0.65	214.00	0.30	Adam Brown

Equipment with Utilization 10% ~ 50%

Equipment	Working Hours	Billing Hours	Utilization (%)	Foreman
TLR1992	84.07	332.00	25.32	Daniel Gill
DD791	95.68	336.00	28.48	Matt Edward
TV221	4.62	16.00	28.85	Henry Liam
DD849	69.17	235.50	29.37	Arnold Adams
DD887	58.58	190.50	30.75	Leo Morris
DD828	76.65	225.00	34.07	Aiden Gold
TLR1456	130.33	379.00	34.39	Abel James
DD869	23.05	66.50	34.66	Arnold Adams

Unpaid Equipment

Equipment	Ttl Working Hours	Ttl Billing Hours	Unpaid Hours	Foreman
PU3355	13.97	12.00	1.97	Gabriel Noah
PU3363	5.30	4.00	1.30	John Truman

DASHBOARD FUNCTIONS:

- The scatter plot of total working hours vs total billing hours demonstrates how the individual equipment was utilized: the closer one triangle (which represents one piece of equipment) is to the border of symmetry shades, the more efficient the equipment was used; on the other hand, the size of the triangle indicates the number of billing hours (the larger the triangle, the more hours had been paid). Thus, the visualization can help users directly find the insufficiently used equipment which is the larger-size triangle away from the border

- The interactive filters of date and construction location enable users to check the equipment utilization for specific projects and periods

- The tables below separately list the equipment of different levels of utilization, offering the direct suggestions for rental strategies on these equipment

RECOMMENDATIONS & FUTURE RESEARCH

RECOMMENDATIONS

- Record all using equipment in the project in the master dataset

- Review equipment with 0 billing hours and 0 utilized time and evaluate its necessity

- Create a multi-shift schedule to utilize equipment in multiple projects to decrease idle time and costs

FUTURE RESEARCH

Analyze equipment by location using their zip code, evaluating their necessity by type and month, to create better strategic plan for their usage

REFERENCES:

[1] Sork, A. (2017, May 9). Why Renting Construction Equipment Beats Buying |

BigRentz. BigRentz: The Nation's Largest Equipment Rental Company.

https://www.bigrentz.com/blog/renting-construction-equipment-beats-buying

[2] Wilkinson, K. (2017, July 12). The Cost of Construction Equipment - Balboa Capital.

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https://www.balboacapital.com/blog/types-construction-vehicles/