EQUIPMENT MAINTENANCE COST ANALYSIS REPORT

FOR

SUMMERS TAYLOR INC.

ENTC 5030 - INVESTIGATIONS IN TECHNOLOGY

Gold Agharese

Summers Taylor Inc., Elizabethton

Due Date: 5/2/2018

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COMPANY BACKGROUND

Summers Taylor is an award-winning, family owned leading materials producer and heavy construction contractor founded in 1932 in Elizabethton, Tennessee. The company has been in business for over 80years and serves the tri-state region of Northeast Tennessee, Southwest Virginia and Western North Carolina ("Summers-Taylor", 2018). The company has a strong team of over 375 employees; own four hot-mix asphalt plants, eight ready-mix concrete plants and truck fleets; it is the largest in the region.

Summers Taylor provides services such as asphalt/concrete manufacturing, site preparation required for major building development, highway construction, piping/utilities, bridge construction, environmental and airport construction. Some of the company’s notable achievements include multiple NAPA quality in construction awards, nine time TDOT awards and was the first in the area to offer warm mix asphalt which is the new green in pavement construction and porous asphalt, HydroFlo.

The company’s vision focus on “quality is our shield” while its mission is based on “providing quality workmanship at a reasonable price”. The company builds on quality which has sustained it for more than seven decades under three generations of leadership while maintaining its long reputation for delivering quality work. Besides quality, the company also believes in its people (workers).

LITERATURE REVIEW ON THE COMPARATIVE ANALYSIS OF EQUIPMENTS – MAINTANANCE

The maintenance of heavy equipment is a critical operation to the business of companies in the heavy construction industry. In most cases, the successful delivery of projects will highly depend on the reliability and efficiency of a company's fleet of equipment. Recent industry evolvement has necessitated project owners requesting potential contractors to summit along their bids, the performance report of their equipment. This development has further raised the requirements for most companies to stand a chance of being competitive in winning and delivery client's expectations in jobs. Publications reveal that exceeding of schedule, cost and failures in many projects arise as a result of poor equipment maintenance practices (Nunnally et al, 1997). It is therefore imperative that construction companies have and retain reliable and cost-effective maintenance regimes that will position them for profitable project delivery.

Alwood et al. (1989) stated that equipment reliability is a critical factor when trying to complete a project within budget and on schedule. Without the proper working equipment, productivity decreases, delays increase, possible injuries occur, and unnecessary costs are incurred. Tatari et al. (2006) investigated that the primary agenda of the equipment maintenance process is to achieve higher productivity, more operational flexibility and viable economic considerations. The past research shows that the appropriate selection of equipment has always been considered as a strategic decision during the construction phase of any project.

Gransberg et al. (2006) proposed two factors that can be considered when establishing proper equipment maintenance culture: (i) type and condition of the site work; which includes the distance to be traveled; and (ii) desired productivity; which is a critical factor that affects equipment selection. Vorster et al. (2009) concluded that preventive maintenance programs are easily understood costs that occur at discrete recurring intervals. Tires, tracks, and ground engaging tools exhibit predictable patterns that are worthy of investigation in their own right. Fuel consumption rates per unit time of equipment operation can also be forecasted in linear fashion (although actual fuel costs are market driven). Earthmoving-scheduling and fleet-assignment methods using various integer programming models for equipment assignment for better utilization and maintainability. They asserted that unit costs of heavy equipment maintenance are affected by factors such as the experience of the operators, condition of equipment, type of soil, and team composition. Therefore, the cost of a good maintenance regime vary throughout projects, and the use of static values is not consistent with jobsite realities.

SCOPE OF THE PROBLEM

For Investigation in technology final project titled "we fix your Technology/related problem – How can we help?" a team of six students from East Tennessee State University (names listed in the Table 1 below) visited Summers Taylor Inc., sequel to an invitation by the company. The aim of the visit was to identify initial technology-related problem that the company has; one which the team can use experimental and statistical study to analyze and propose a workable solution to.

After the first meeting with the company, the group was provided with the company's equipment maintenance cost data. The data consist of about 240 equipment IDs (equipment specific), its labor cost, parts cost, sublet vendor cost and the date of transaction with detailed description of the maintenance work carried out.

The group's task is to help the company troubleshoot this equipment maintenance cost data using statistical tool to determine variations, abnormalities and possibly suggest ways to reduce maintenance cost/the equipment that is maintenance cost effective given the data provided.

For this reason, this paper presents specified aims/objectives of study; Problem specific literature review, Data collection, analysis, evaluation of the problem, solution design and implementation method suggested for achieving possible solution.

Table 1: Key personnel

PERSONEL	NAME
Client	Summers – Taylor Inc
Sponsor	ETSU
Client Rep	Mr. Grant Summers
Project Team Leader	Gold Agharese
Team	Olufunke Bankole, Kenneth Ifalade, Patience Isine, Tare-Ebi Ojokai, Adesanmi Solesi

OBJECTIVE OF THE STUDY

The team was presented with equipment maintenance cost data for several periods. See Appendix C.1 for list of equipment. The data consist of over 30,000 maintenance transactions for all construction equipment for several periods. The data includes several information both measures and qualitative in relation to each maintenance activity carried out. However only the information used by the team will be stated in this report. It includes an equipment ID which is unique to just one equipment, equipment description, which is the brand of the equipment, Item code description which specifies the category of maintenance carried out on an equipment. The quantitative data consist of the labor cost, parts cost, and sublet vendor costs. With no specific problem stated by the company, the team decided to find ways the company might be able to reduce cost by analyzing the data and presenting the company with useful information that can benefit the company in terms of efficiency. Tableau software, and mini tab statistical software were used for the data analysis. The following specific objectives are stated below:

- To find anomalies and trends by comparing total maintenance cost between periods
- To find the maintenance categories with the highest frequency of occurrence, together with the top four equipment with the highest maintenance cost within each category.
- To find twenty equipment with the highest labor costs, parts cost, sublet vendor costs, and total costs (the sum total of labor, parts, and sublet vendor costs) for the entire period covered by the data.
- To find twenty equipment with the highest total maintenance costs for specific periods.

PRESENTATION OF RESULTS & ANALYSIS

Normality of Data on Major Maintenance Issues

The normality test is to determine that the maintenance data has been drawn from normally distributed population (within a reasonable tolerance). A valid normality test is an indication of the reliability of further tests that will be carried out on the data.

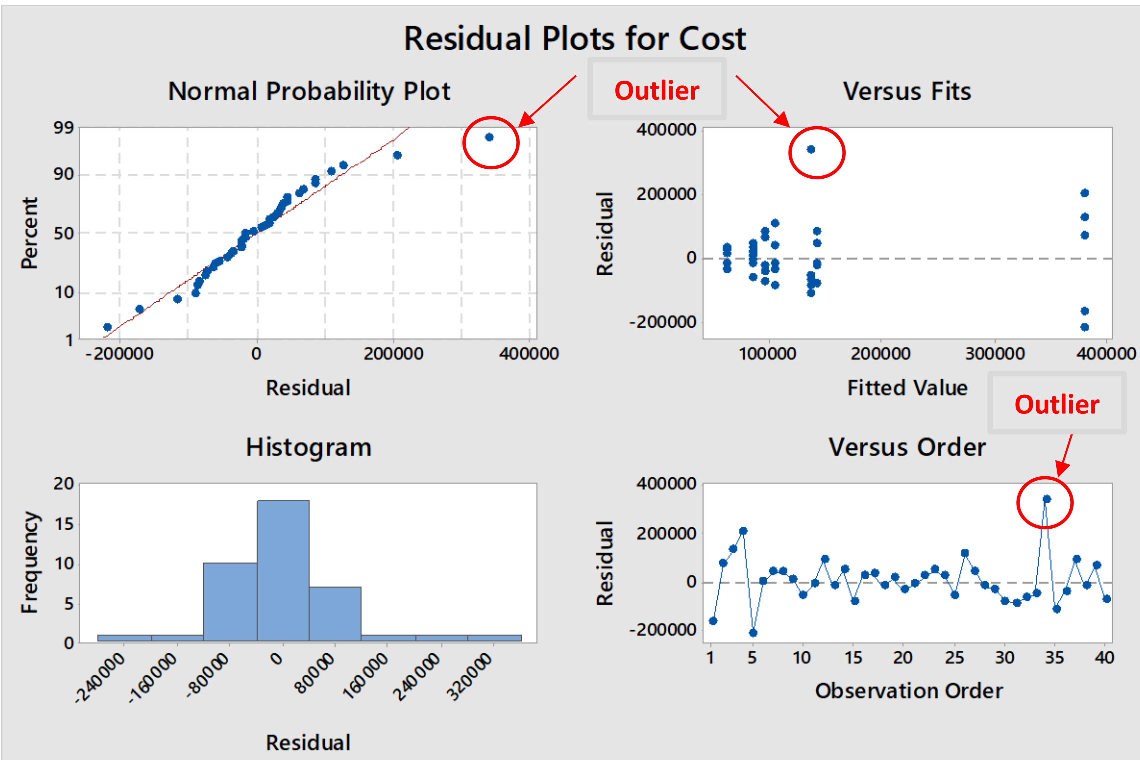

Figure 1: Residual Plot of Maintenance cost

Figure 1 above is the residual plots of maintenance cost arising from the three cost components (Labor cost, Parts cost and Vendor cost) showing even spread of the data points along the straight line of the normal probability plot with a visible outlier on a single data point; randomly scattered on the residual vs fitted value and on the residual vs observation order with the same noticeable outlier; relatively skewed on both sides of the histogram plot. There are no evident problems indicated by these plots that violates the model assumptions. Therefore, the model assumption for normality of data distribution is reasonably satisfied.

The Box Plot

In its simplest form, the boxplot is a visual display that presents five sample statistics - the minimum, the lower quartile, the median, the upper quartile and the maximum.

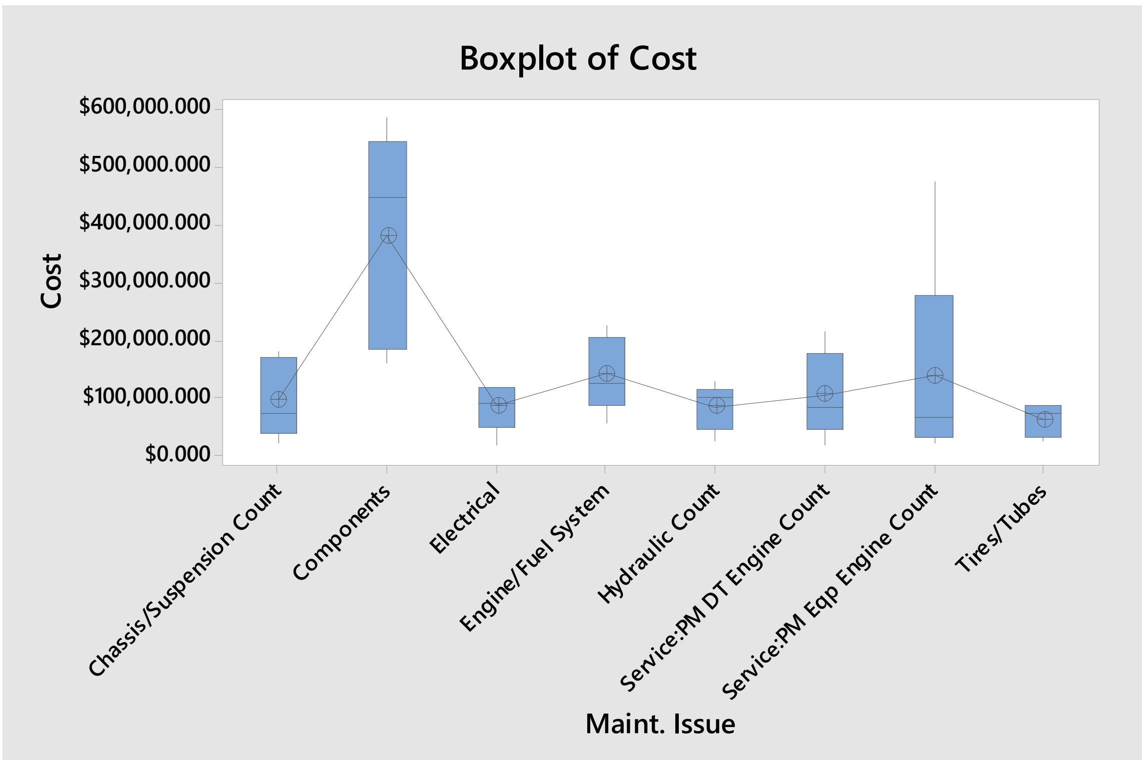

Figure 2: Boxplot of cost

Figure 2 above shows the Boxplot, which indicate the total maintenance is affected by the different cost variables (Labor cost, Parts cost and Vendor cost). The components variable is shown to have more frequency of occurrence and have a higher contribution to the total maintenance cost. Also, the boxplot of the Service: PM Eqp Engine Count is skewed to the right, with the upper whisker is much longer than the bottom whisker. This identifies the variable with the outlier captured by the normality plot. Further investigation revealed the equipment Id to be S4450 (of the Caterpillar D8R Dozer subgroup).

Pareto Analysis

The initial data presented to the team represented the company's maintenance cost from 1994 till date. The cost were categorized as Labor cost, Parts cost and Vendor cost. At a glance, the data did not provide any insight into what equipment or equipment subgroups might be contributing more to the company's maintenance expenses. One method the team used in identifying the most significant contributors to the maintenance cost was Pareto Analysis. In this method, the data was decomposed into systems i.e. equipment subgroups, cost type and major recurring maintenance issues. Using the recorded cost categories, the weighted values (i.e. cost multiplied by its frequency) were plotted as a function of cumulative percentage of the major maintenance issues (see Appendix 2 for Pareto data). This plot usually shows that approximately 80% of maintenance cost is as a result of 20% of the failure types (or maintenance issues). This can reveal what issues the maintenance department should focus on. Once specific issues have been identified with a subgroup, further analysis can then be carried out to drill down to the actual equipment Id contributing more of the maintenance issue.

Shown in figure 3 below is the weighted Pareto analysis carried out on 8 most frequent maintenance issues for the period 2014 - 2018. A weighted Pareto chart accounts for the severity of the maintenance cost for each of the issues weighted against the frequencies with which they occurred.

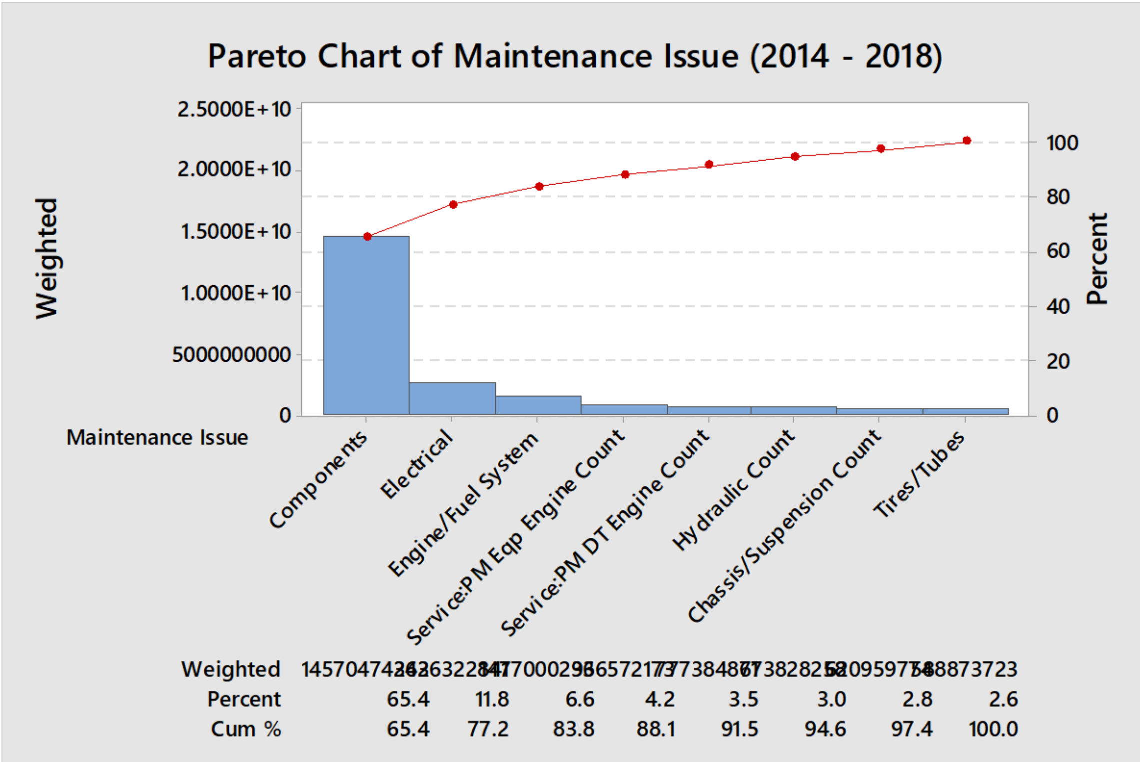

Figure 3: Pareto Chart of Maintenance Issue

From the above figure 3, it is evident that component costs accounts for 65.4% of total maintenance cost for the period. Combine that with electrical cost accounts for 77.2% of total maintenance cost for the period. And Combine that with Engine/Fuel System cost accounts for 83.8.2% of total maintenance cost for the period. For the purpose effecting better maintenance regime and cost control, it will be insightful for the company to pay greater attention to these three major maintenance issues (Component cost, electrical cost and Engine/Fuel System cost).

Figure 4 below shows further analysis of the three major cost contributors (Component cost, electrical cost and Engine/Fuel System cost) to identify the specific equipment Ids responsible for the greater part of the cost associated with them. This was achieved by identifying 5 equipment Ids that makes the greater contribution to each of the three categories of maintenance issues.

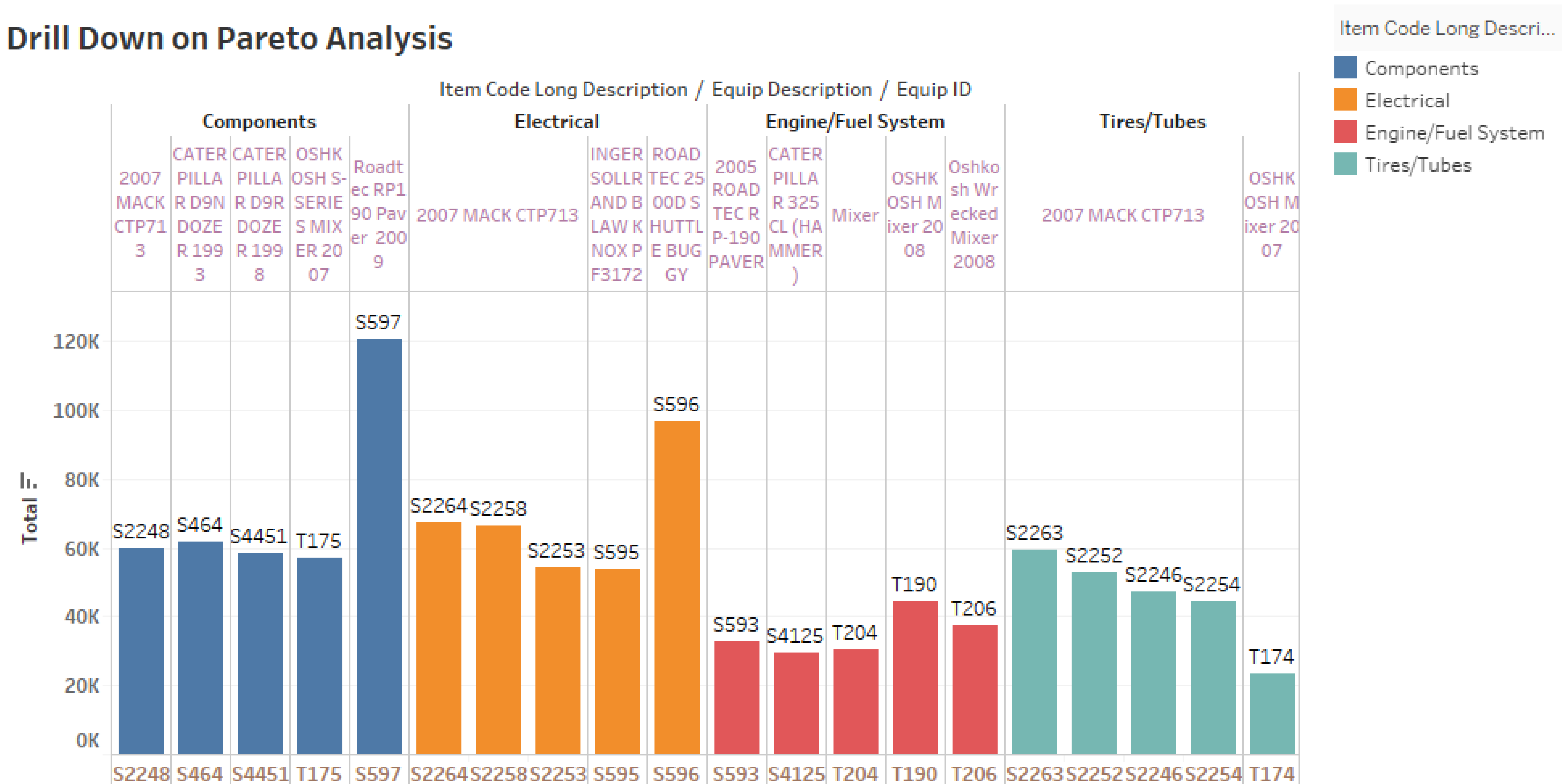

Figure 4: Further Analysis of the three major cost contributors

From the total components cost which accounted for 65.4% of total maintenance cost for the period, the equipment id S597 (from the Roadtec RP190 Paver 2009 subgroup) is the highest contributor ($120,585) to maintenance cost spent on components.

Also Electrical cost accounted for 11.8% of the total maintenance cost for the period, the equipment Id S596 from the (Roadtec 2500D Shuttle Buggy) is the highest contributor ($96,606) to electrical cost of maintenance. While Engine/Fuel System cost accounted for 6.6% of the total maintenance cost for the period, the equipment Id T190 from the (Oshkosh Mixer 2008) is the highest contributor ($24,164) to Engine/Fuel System cost of maintenance.

A Drill-down On the Maintenance Cost Variables

For better understanding of where the larger part of the maintenance cost are accruing from, a drilled-down analysis was carried out to identify the top 10 equipment subgroup and equipment IDs in each of the cost components (i.e Labor cost, Parts cost and Vendor cost), which are responsible for larger part of the overall maintenance cost.

1. Top 10 Labor Cost

Figure 5 below provide insight into the top 10 equipment subgroup and equipment Ids responsible for greater part of the labor cost in the company's maintenance regime. The chart reveals equipment Id S597 (of the Roadtec RP190 Paver 2006 subgroup) to have highest labor maintenance cost throughout the maintenance data period.

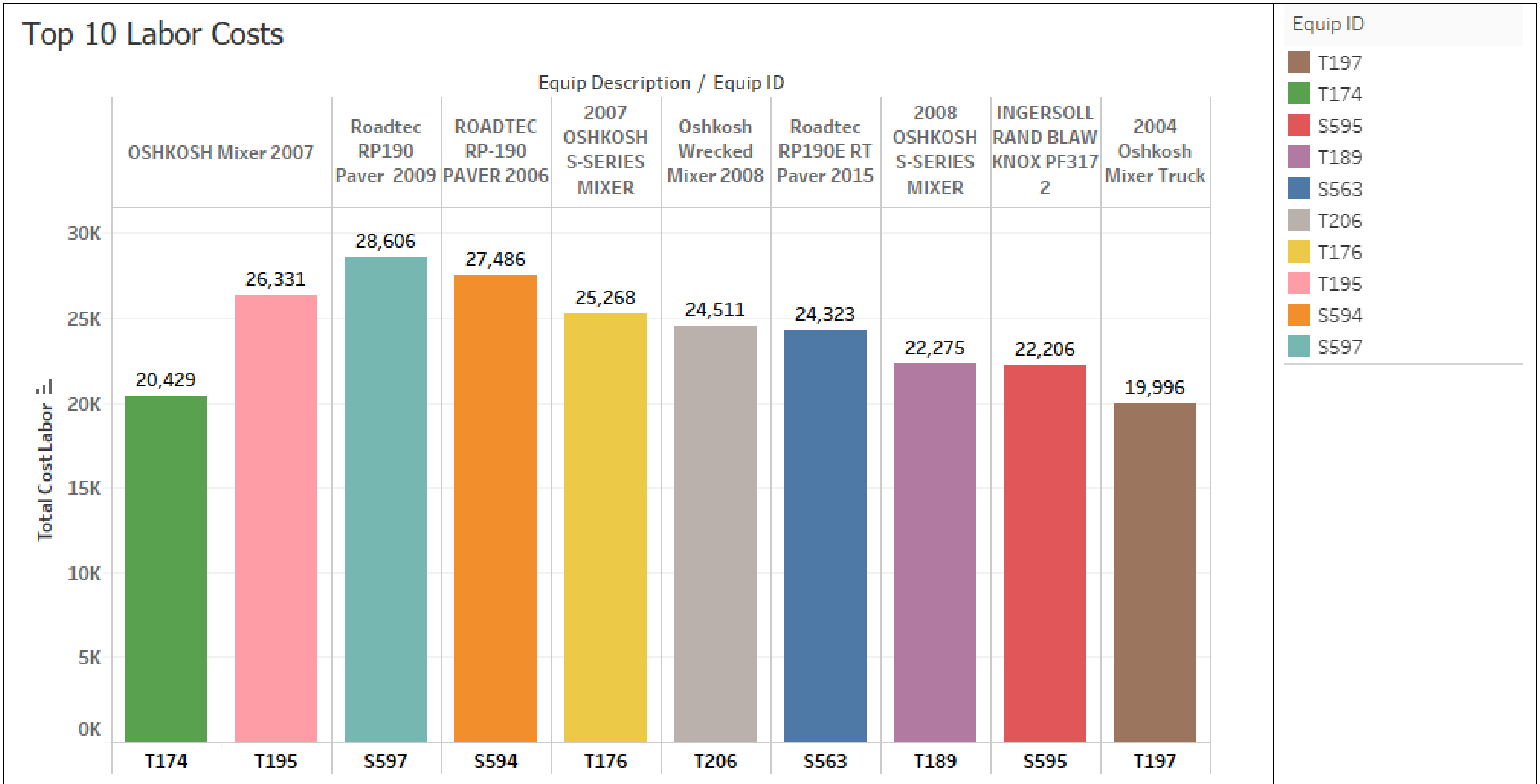

Figure 5: Top 10 Labor Cost

2. Top 10 Parts Cost

Figure 6 below provide insight into the top 10 equipment subgroup and equipment ids responsible for greater portion of the parts cost in the company's maintenance regime.

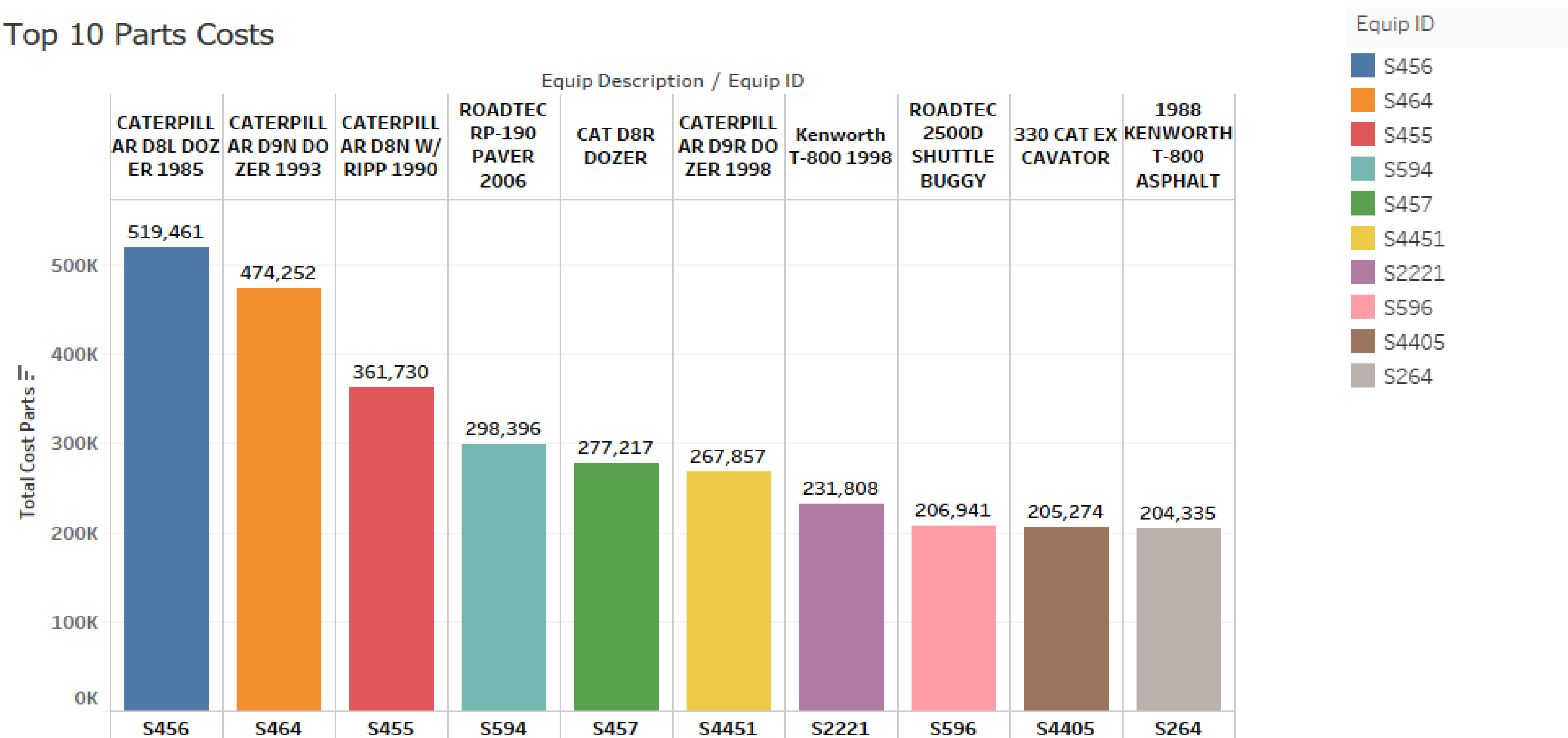

Figure 6: Top 10 Parts Cost

The chart reveals equipment Id S456 (of the Caterpillar D8L Dozer 1985 subgroup) has the highest parts cost throughout the maintenance data period.

3. Top 10 Vendor Cost

Figure 7 below provide insight into the top 10 equipment subgroup and equipment Ids responsible for greater part of the vendor cost in the company's maintenance regime. The chart reveals equipment Id S4450 (of the Caterpillar D8R Dozer subgroup) has the highest vendor cost ($398,363) throughout the maintenance data period.

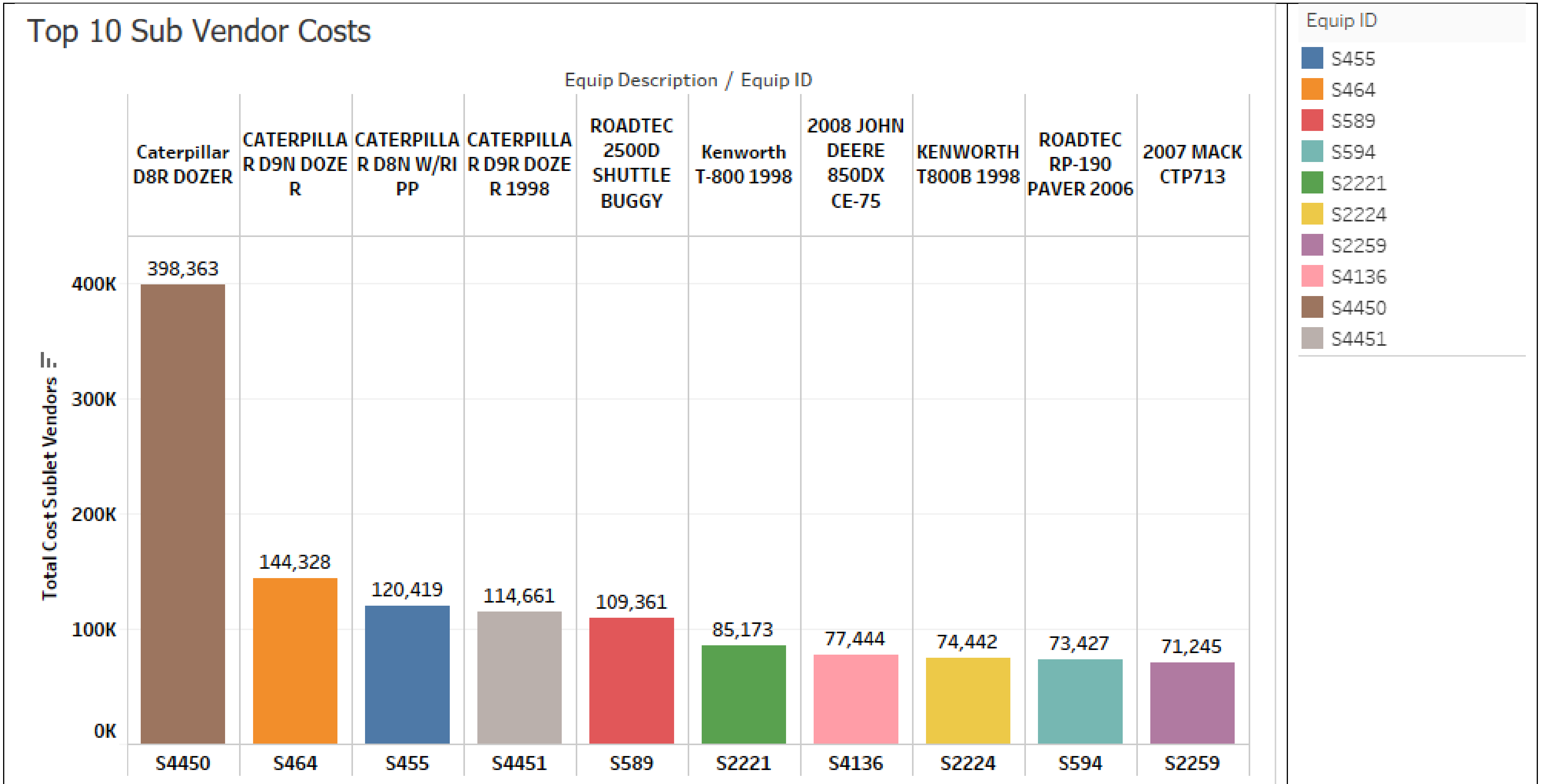

Figure 7:Top 10 Sub Vendor Costs

4. Top 10 Total Maintenance Cost

Table 2 below provide insight into the top 10 equipment subgroup and equipment ids responsible for greater part of the total maintenance cost in the company's entire maintenance history (1994 – 2018). It can be seen from the following Figure 8, that the Caterpillar series are the first 4 most expensive equipment to maintain. The equipment Id S464 (of the Caterpillar D9N Doze R1993 subgroup) has the highest overall maintenance cost for the entire maintenance data period, with a total maintenance cost of $624,135, from which 0.89% is contributed by labor cost, 75.99% is contributed by parts cost and 23.12% is contributed by vendor cost respectively.

Table 2: Top 10 equipment Subgroup and Equipment IDs

	Equip Description / Equip ID									
	CATERPILLAR D9N DOZER 1993	CATERPILLAR D8L DOZER 1985	Caterpillar D8R DOZER	CATERPILLAR D8N W/RIPP 1990	ROADTEC RP-190 PAVER 2006	CATERPILLAR D9R DOZER 1998	CAT D8R DOZER	Kenworth T-800 1998	2005 ROADTEC RP-190 PAVER	KENWORTH T800B 1998
	S464	S456	S4450	S455	S594	S4451	S457	S2221	S593	S2224
Labor % of Total cost	0.89%	0.56%	0.75%	1.13%	6.88%	1.55%	1.41%	2.23%	5.73%	2.55%
Parts % of Total cost	75.99%	87.81%	26.83%	74.17%	74.73%	68.94%	83.71%	71.50%	70.88%	70.91%
Vendor % of Total cost	23.12%	11.63%	72.42%	24.69%	18.39%	29.51%	14.88%	26.27%	23.38%	26.55%
Total	624,135	591,582	550,062	487,677	399,309	388,555	331,182	324,198	284,100	280,418

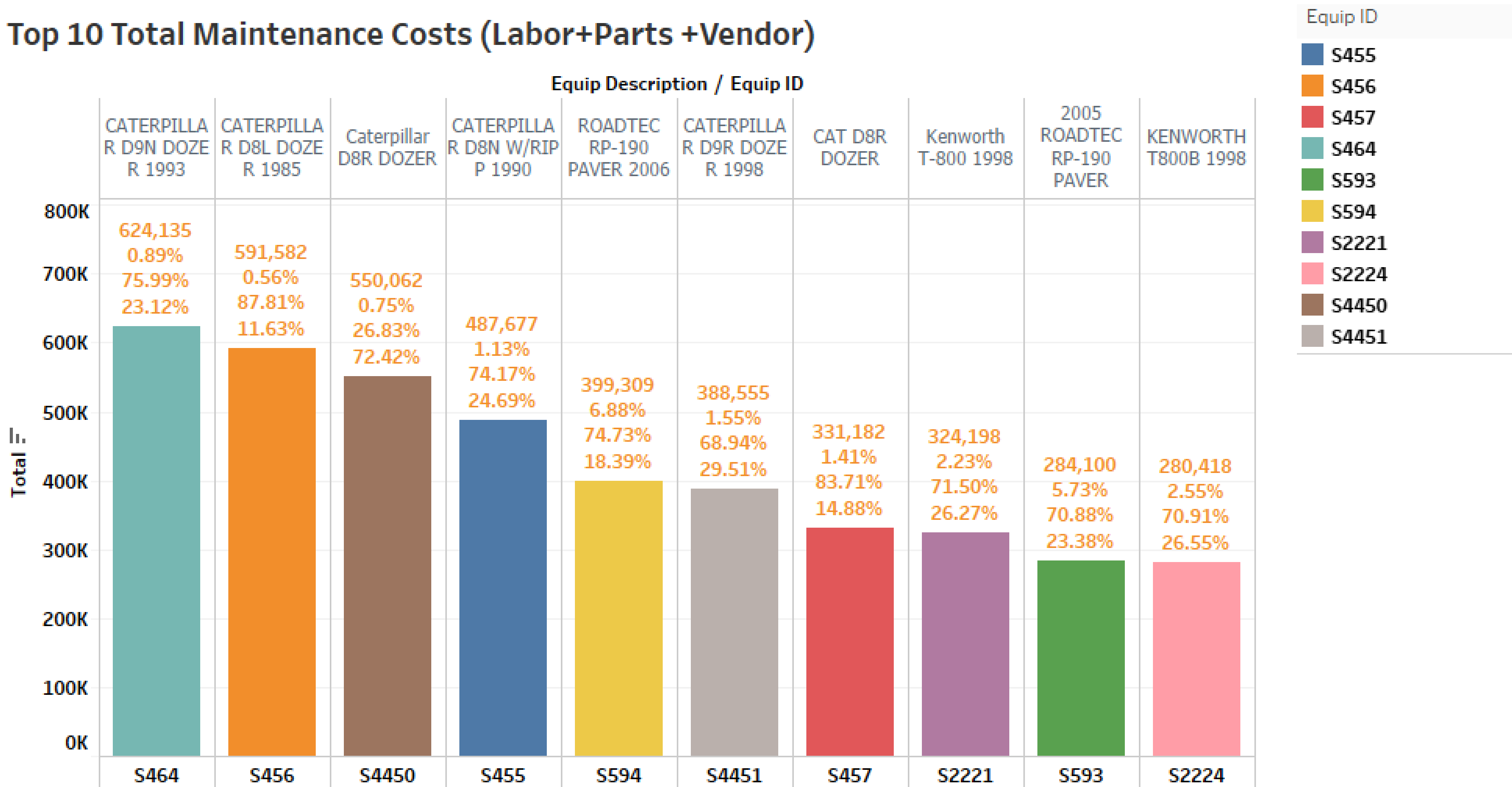

Figure 8: Top 10 Total Maintenance Costs (Labor + Parts + Vendor)

5. Maintenance overview By Period

A quick overview of the monthly maintenance cost for the period of 2012 – 2017 is depicted in figure 9 below.

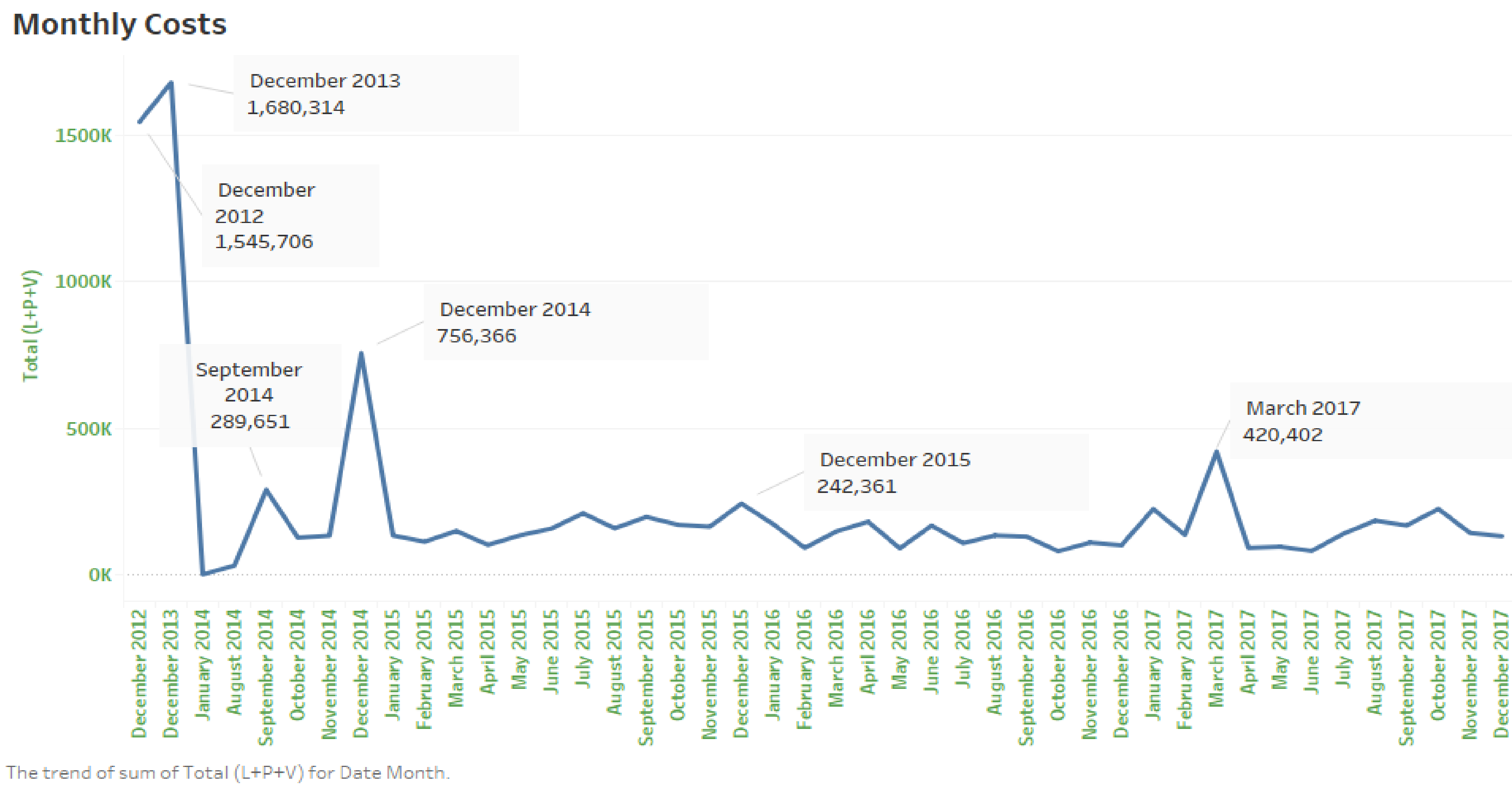

Figure 9: Maintenance Overview by Period

The maintenance summary shows significant peaks in maintenance cost during for the period indicated. Generally, the peak cost are seen to reflect in December of each year (with the exception of maximum cost peak occurring in March 2017). Within this period, maintenance cost for December 2013 was highest with total cost of $1,680,314; followed by December 2014 recording $756,366. These two periods also present an interesting observation as can be seen in the sharp decline of approximately 55% reduction in annual peak maintenance cost between December 2013 and December 2014.

Top 20 Equipment Maintenance Cost for 2017

Figure 10 below provide insight into major equipment Ids and their respective maintenance cost for the year 2017. The chart reveals equipment Id S4450 (of the Caterpillar D8R Dozer subgroup) has the highest overall maintenance cost for the year 2017.

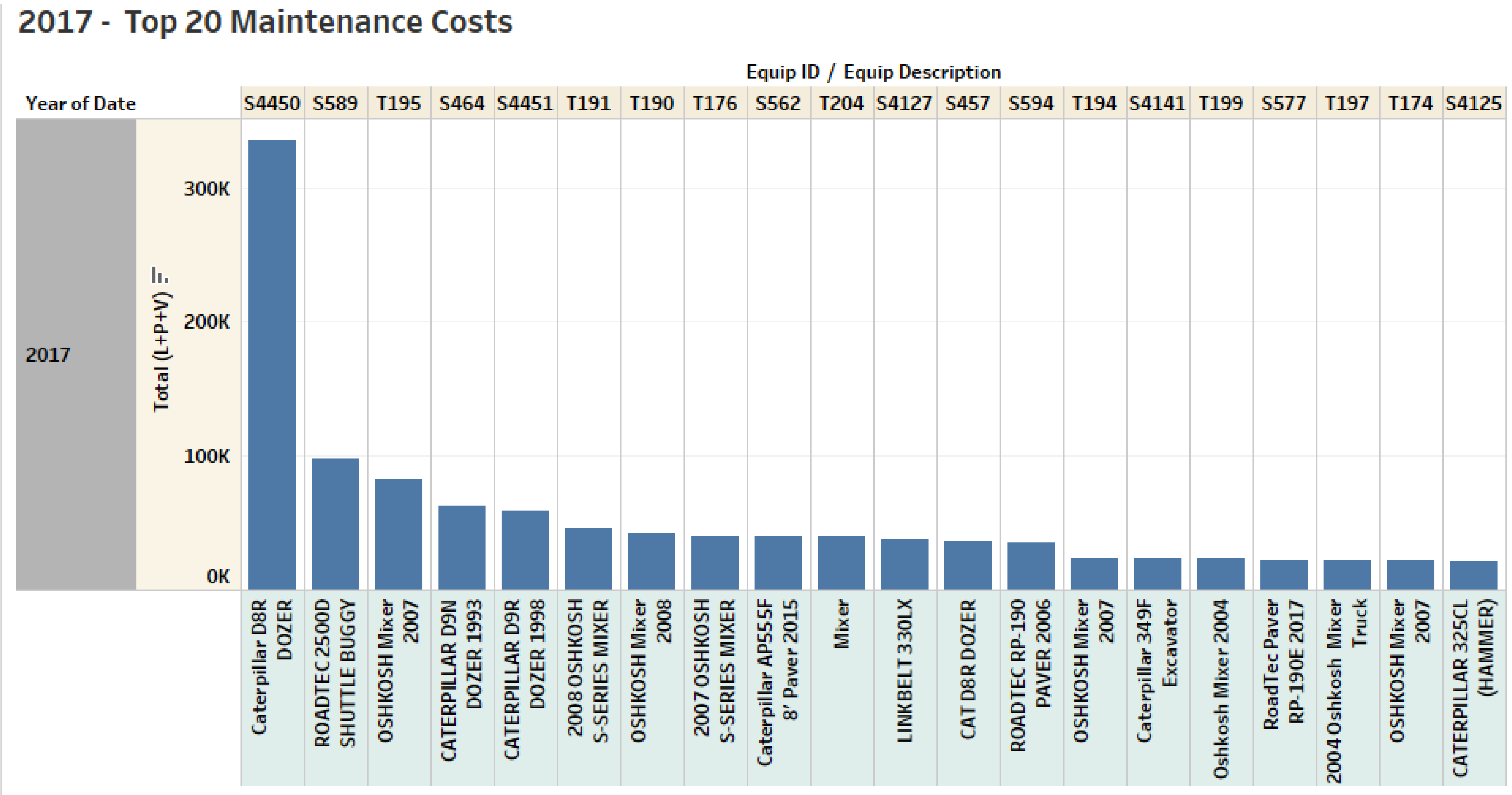

Figure 10: Top 20 Maintenance Costs - 2017

Top 20 Equipment Maintenance Cost for 2016

Figure 11 below provide insight into major equipment Ids that have highest maintenance cost for the year 2016.

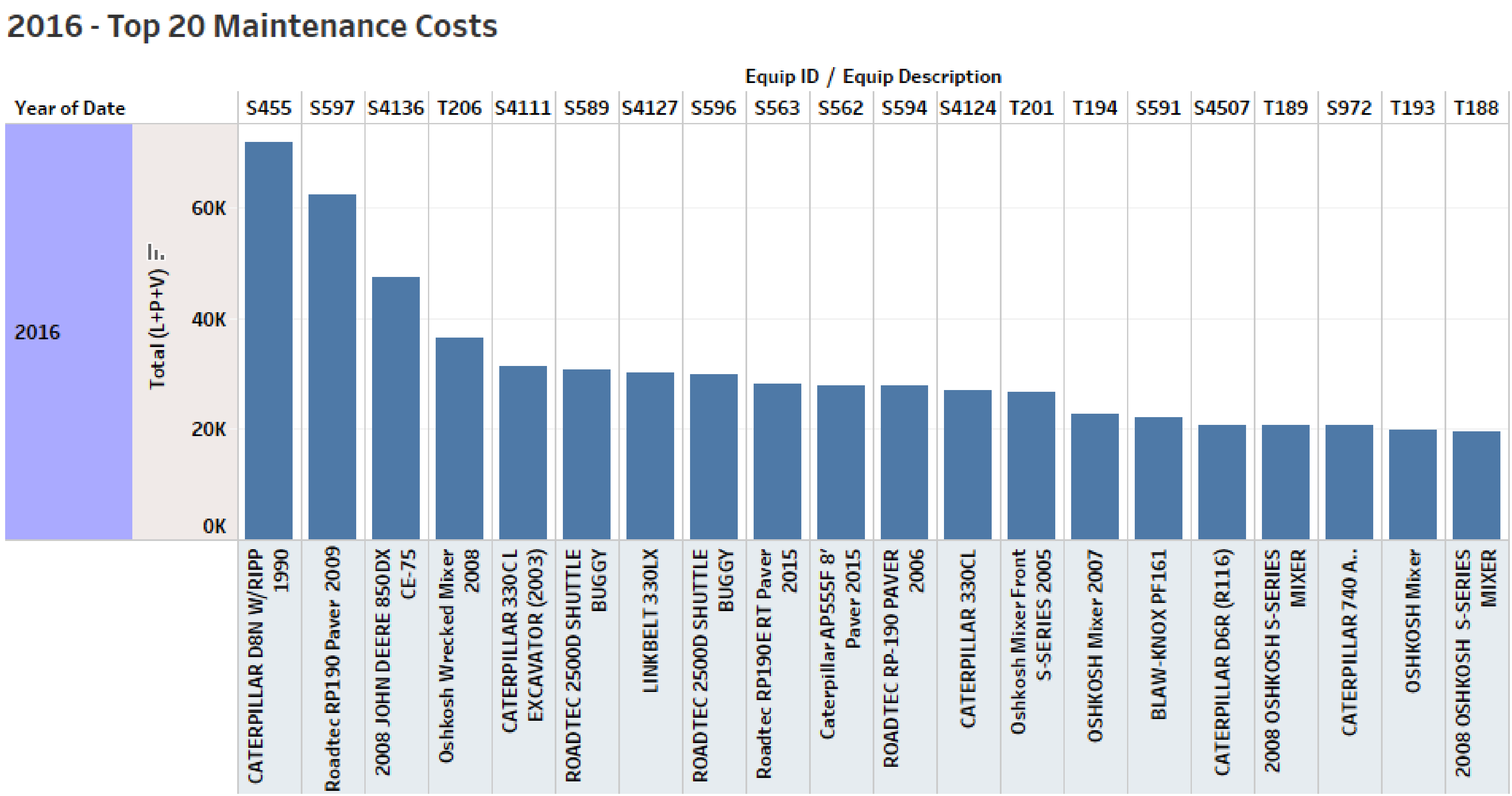

Figure 11: Top 20 Maintenance Costs - 2016

The chart reveals equipment Id S445 (of the Caterpillar D8N W/RIPP 1990 subgroup) has the highest overall maintenance cost for the year 2016.

Top 20 Equipment Maintenance Cost for 2015

Figure 12 below provide insight into major equipment Ids that have highest maintenance cost for the year 2015.

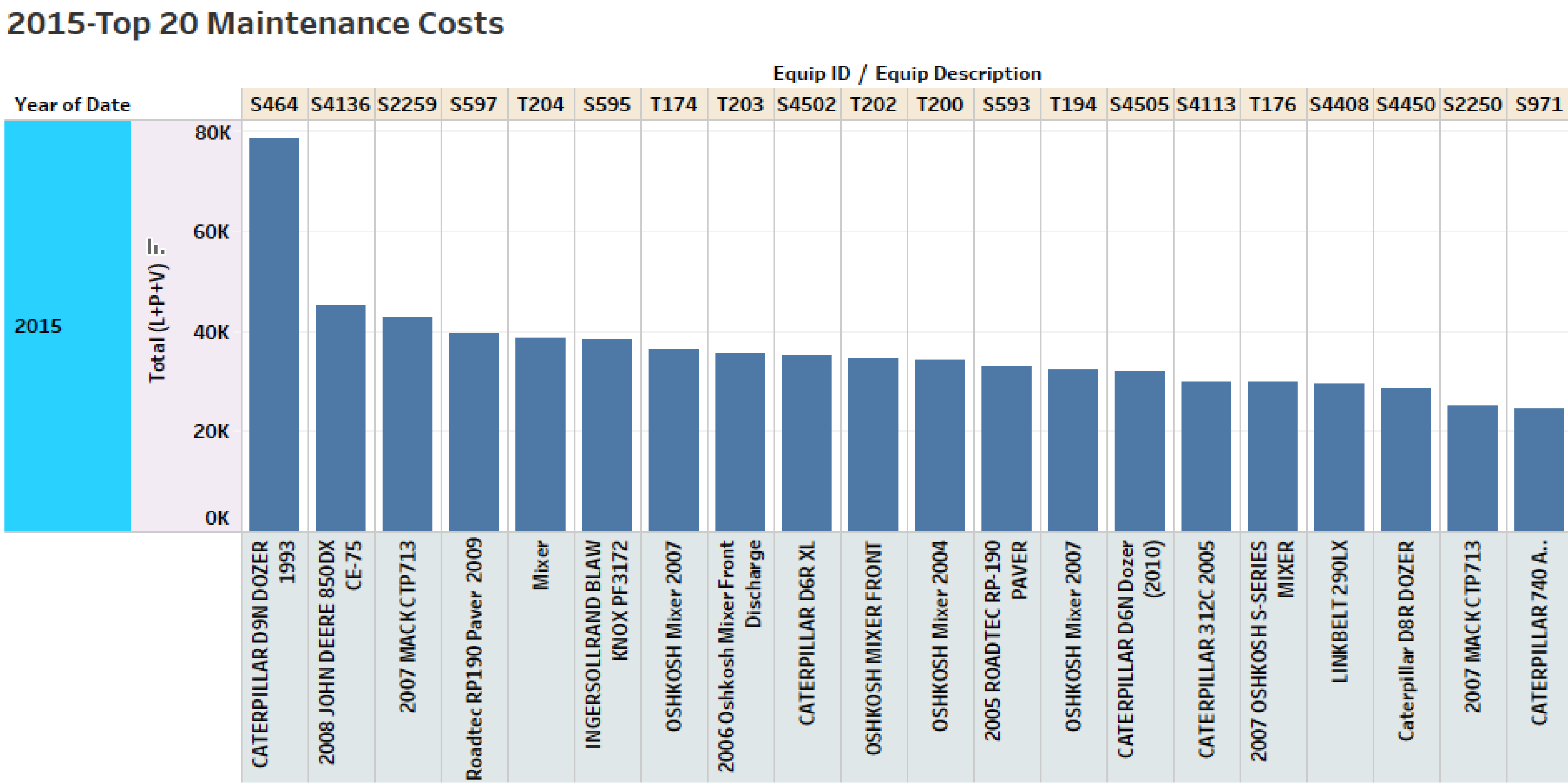

Figure 12: Top 20 Equipment Maintenance Cost - 2015

The chart reveals equipment Id S464 (of the Caterpillar D9N Dozer 1993 subgroup) has the highest overall maintenance cost for the year 2015.

Total Maintenance Cost for 2018 (Inconclusive)

Figure 13 below provide a brief overview of maintenance cost so far for the year 2018.

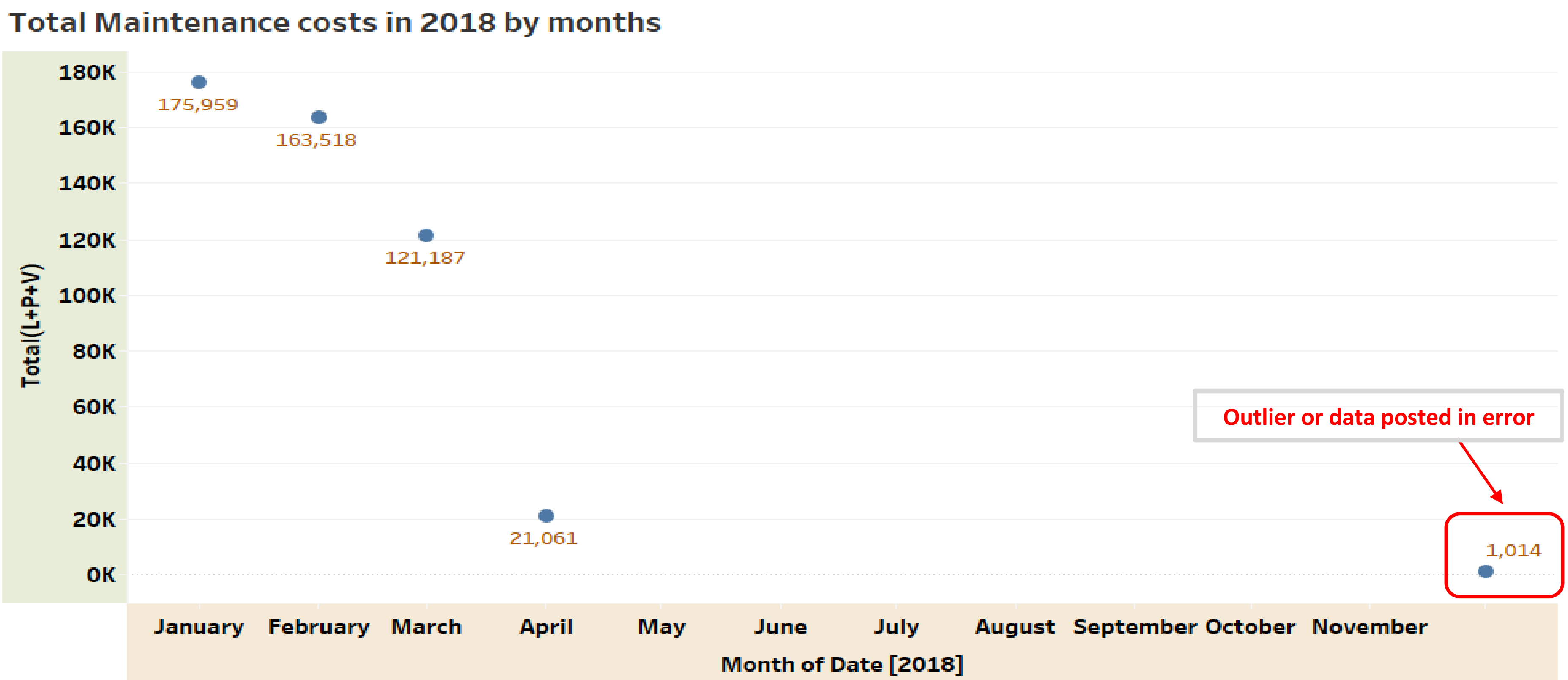

Figure 13: Total Maintenance Cost - 2018

Although the year 2018 is inclusive, there seems to be drastic cumulative reduction in monthly maintenance cost. However, a maintenance data that appears to be an outlier is identified in a future date (December 26th, 2018). Further investigation revealed the equipment Id to be S4117 (belonging to the 1999 CATERPILLAR 320 subgroup).

DISCUSSION OF IDENTIFIED PROBLEMS AND RECOMMENDATIONS

1. For Service: PM Eqp Engine maintenance expenses, equipment Id S4450 (of the Caterpillar D8R Dozer subgroup) had an unusual vendor cost of $333,598 in 2017. In the same year, the mean vendor cost for Service: PM Eqp Engine maintenance issues stood at $1,846. Hence, vendor maintenance cost for the equipment Id S4450 had approximately 99% deviation from the mean. This should be subject to further investigation to identify the reason for the unusual high vendor cost for that period. Information gathered from this could be helpful in helping to the company in modifying its maintenance regime to better guide against having similar failures that warranted that sudden surge in vendor cost for rectifying the associated Service: PM Eqp Engine maintenance issue.
2. As depicted in figure 3, the Pareto analysis showed the three major maintenance issues that absorbs more than 80% of the company's maintenance cost, namely the Components cost, electrical cost and Engine/Fuel System cost. For the purpose effecting better maintenance regime and cost control, it will be insightful to pay greater attention to these three major maintenance issues. A more efficient maintenance and repair approach in these three areas would undoubtedly have significant savings for the company. A good way to start is to see the possibility of emphasizing better maintenance culture for equipment id S597 (from the Roadtec RP190 Paver 2009 subgroup) due to the extremely high cost of fixing its components failures. Could a different equipment that cost less in component replacement or better component reliability be an option?

   Another aspect to look into would be finding cost-effective ways to resolve the electrical issues coming from equipment Id S596 (of the Roadtec 2500D Shuttle Buggy subgroup) because of the high cost of resolving the electrical issues associated with the equipment. Focusing more on proactive electrical maintenance for this equipment could minimize its electrical failures.

3. As revealed by figure 8, the Caterpillar series are the first 4 most expensive equipment to maintain. An improved maintenance culture for this series would be worth the time and investment.
4. Figure 13 showed a maintenance data that appears to be an outlier (posted on a future date - December 26th, 2018), with equipment Id S4117 (belonging to the 1999 CATERPILLAR 320 subgroup). Further investigation should be made to ascertain the correctness of this data.
5. One of the interesting observation captured from the data analysis is the fact that most maintenance cost peaks took place mostly in December each year. It is unknown why this is the case. This invariably possess questions that the company might want to investigate.
    - Are there certain kind of high cost maintenance reserved to be carried out during that time of the year?
    - Is December likely a project peak period when almost all equipment are deployed to project sites, thereby experiencing more breakdowns?
    - Is weather a factor?
    - Is the cost of securing vendor maintenance cost higher for the period?

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Appendix A

A.1 Minitab Data for Normality Test on Major Maintenance Issues

Cost	Maintenance Issue
$206,045.409	Components
$447,288.336	Components
$505,163.559	Components
$583,999.383	Components
$159,345.767	Components
$78,831.060	Electrical
$117,267.500	Electrical
$118,110.339	Electrical
$90,271.451	Electrical
$18,243.119	Electrical
$124,037.537	Engine/Fuel System
$224,930.287	Engine/Fuel System
$116,917.786	Engine/Fuel System
$184,097.296	Engine/Fuel System
$55,365.822	Engine/Fuel System
$83,518.805	Tires/Tubes
$89,462.700	Tires/Tubes
$38,686.828	Tires/Tubes
$72,497.220	Tires/Tubes
$22,061.033	Tires/Tubes
$67,018.342	Hydraulic Count
$99,933.696	Hydraulic Count
$128,197.941	Hydraulic Count
$102,011.842	Hydraulic Count
$22,407.455	Hydraulic Count
$212,822.636	Service:PM DT Engine Count
$142,634.925	Service:PM DT Engine Count
$82,413.961	Service:PM DT Engine Count
$67,677.913	Service:PM DT Engine Count
$17,589.778	Service:PM DT Engine Count
$44,249.602	Service:PM Eqp Engine Count
$64,444.476	Service:PM Eqp Engine Count
$80,760.910	Service:PM Eqp Engine Count
$474,947.645	Service:PM Eqp Engine Count
$18,728.054	Service:PM Eqp Engine Count
$52,822.065	Chassis/Suspension Count
$179,718.447	Chassis/Suspension Count
$71,173.638	Chassis/Suspension Count
$156,028.810	Chassis/Suspension Count
$19,762.658	Chassis/Suspension Count

A.2 Minitab Output

One-way ANOVA: Cost versus Maintenance Issue

Method

Null hypothesis	All means are equal
Alternative hypothesis	Not all means are equal
Significance level	α = 0.05

Equal variances were assumed for the analysis.

Factor Information

Factor	Levels	Values
Maint. Issue	8	Chassis/Suspension Count, Components, Electrical, Engine/Fuel System, Hydraulic Count, Service:PM DT Engine Count, Service:PM Eqp Engine Count, Tires/Tubes

Analysis of Variance

Source	DF	Seq SS	Contribution	Adj SS	Adj MS	F-Value	P-Value
Maint. Issue	7	3.66415E+11	50.35%	3.66415E+11	52345037431	4.64	**0.001**
Error	32	3.61311E+11	49.65%	3.61311E+11	11290982999		
Total	39	7.27727E+11	100.00%				

Model Summary

S	R-sq	R-sq(adj)	PRESS	R-sq(pred)
106259	50.35%	39.49%	5.64549E+11	22.42%

Means

Maint. Issue	N	Mean	StDev	95% CI
Chassis/Suspension Count	5	95901	68748	(-895, 192697)
Components	5	380368	187588	(283572, 477165)
Electrical	5	84545	40801	(-12251, 181341)
Engine/Fuel System	5	141070	65388	(44274, 237866)
Hydraulic Count	5	83914	40662	(-12882, 180710)
Service:PM DT Engine Count	5	104628	75142	(7832, 201424)
Service:PM Eqp Engine Count	5	136626	190543	(39830, 233422)
Tires/Tubes	5	61245	29425	(-35551, 158041)

Pooled StDev = 106259

Appendix B

B.1 Parameters of Interest for Pareto Analysis

Maintenance Issue	Freq. of Occurrence	Total Cost	Weighted
Components	7550	1929864.151	1.45705E+10
Electrical	3291	798031.857	2.62632E+09
Engine/Fuel System	2094	705348.728	1.47700E+09
Tires/Tubes	1923	306226.585	5.88874E+08
Hydraulic Count	1606	419569.277	6.73828E+08
Service:PM DT Engine Count	1486	523139.213	7.77385E+08
Service:PM Eqp Engine Count	1371	683130.688	9.36572E+08
Chassis/Suspension Count	1295	479505.617	6.20960E+08

Appendix C

C.1: List of Equipment

Equipment ID	Equipment Description
R242	Caterpillar 740
R243	Caterpillar 740
R244	Caterpillar 740B
S968	CATERPILLAR 740 ARTICULATED
S969	CATERPILLAR 740 ARTICULATED
S970	KOMATSU HM400-2 ARTICULATED
S971	CATERPILLAR 740 ARTICULATED TRUCK W/BED
S972	CATERPILLAR 740 ARTICULATED TRUCK W/BED
S973	CATERPILLAR 740 ARTICULATED TRUCK W/BED
S974	CATERPILLAR 740B ARTICULATED TRUCK
S975	Caterpillar 745C ARTICULATED TRUCK W/BED
S976	Caterpillar 745C ARTICULATED TRUCK W/BED
S169	1989 FORD DUMP TRUCK
S176	1995 FORD LNT 8000 TRUCK
S179	FORD F800 TRUCK 1999
S185	1974 FORD LT-9000
S199	1985 INTERNATIONAL
S207	1992 FORD DUMP TRUCK
S2211	FORD LT 9000 1995
S2213	1995 LT 9000 FORD TRUCK
S2216	1995 LT 9000 FORD TRUCK
S2219	1998 KENWORTH T800B TRUCK
S2220	1998 KENWORTH T800B TRUCK
S2221	Kenworth T-800 1998
S2222	1998 KENWORTH T800B TRUCK
S2223	1998 KENWORTH T800B TRUCK
S2224	KENWORTH T800B 1998
S2225	1998 KENWORTH T800B TRUCK
S2226	1998 KENWORTH T800B TRUCK
S2227	1998 KENWORTH T800B TRUCK
S2228	1998 KENWORTH T800B TRUCK
S2229	2005 MACK CV713
S2230	2005 MACK CV713
S2231	2005 MACK CV713
S2232	2005 MACK CV713
S2233	2005 MACK CV713
S2234	2005 MACK CV713
S2235	2005 MACK CV713
S2236	2005 MACK CV713
S2237	2005 MACK CV713
S2238	2005 MACK CV713
S2239	2005 MACK CV713
S2240	2005 MACK CV713
S2241	2005 MACK CV713
S2242	2005 MACK CV713
S2243	2005 MACK CV713
S2244	2005 MACK CV713
S2245	2007 MACK CTP713

Equipment ID	Equipment Description
S2246	2007 MACK CTP713
S2247	2007 MACK CTP713
S2248	2007 MACK CTP713
S2249	2007 MACK CTP713
S2250	2007 MACK CTP713
S2251	2007 MACK CTP713
S2252	2007 MACK CTP713
S2253	2007 MACK CTP713
S2254	2007 MACK CTP713
S2255	2007 MACK CTP713
S2256	2007 MACK CTP713
S2257	2007 MACK CTP713
S2258	2007 MACK CTP713
S2259	2007 MACK CTP713
S2260	2007 MACK CTP713
S2261	2007 MACK CTP713
S2262	2007 MACK CTP713
S2263	2007 MACK CTP713
S2264	2007 MACK CTP713
S2265	KENWORTH T880 2015 DUMP TRUCK
S2266	KENWORTH T880 2015 DUMP TRUCK
S2267	KENWORTH T880 2015 DUMP TRUCK
S2268	KENWORTH T880 2015 DUMP TRUCK
S2269	KENWORTH T880 2015 DUMP TRUCK
S2270	KENWORTH T880 2015 DUMP TRUCK
S2271	KENWORTH T880 2015 DUMP TRUCK
S2272	KENWORTH T880 2015 DUMP TRUCK
S2273	KENWORTH T880 2015 DUMP TRUCK
S2274	KENWORTH T880 2015 DUMP TRUCK
S2275	KENWORTH T880 2015 DUMP TRUCK
S2276	KENWORTH T880 2015 DUMP TRUCK
S2277	KENWORTH T880 2015 DUMP TRUCK
S2278	KENWORTH T880 2015 DUMP TRUCK
S2279	KENWORTH T880 2015 DUMP TRUCK
S2280	KENWORTH T880 2015 DUMP TRUCK
S2281	KENWORTH T880 2015 DUMP TRUCK
S2282	KENWORTH T880 2015 DUMP TRUCK
S2283	KENWORTH T880 2015 DUMP TRUCK
S2284	KENWORTH T880 2015 DUMP TRUCK
S2285	KENWORTH T880 2015 DUMP TRUCK
S2286	KENWORTH T880 2015 DUMP TRUCK
S2287	KENWORTH T880 2017 DUMP TRUCK
S2288	KENWORTH T880 2017 DUMP TRUCK
S2289	KENWORTH T880 2017 DUMP TRUCK
S2290	KENWORTH T880 2017 DUMP TRUCK
S2291	KENWORTH T880 2017 DUMP TRUCK
S2292	KENWORTH T880 2017 DUMP TRUCK
S2293	KENWORTH T880 2017 DUMP TRUCK
S2294	KENWORTH T880 2017 DUMP TRUCK
S2295	KENWORTH T880 2017 DUMP TRUCK
S2296	KENWORTH T880 2017 DUMP TRUCK
S2297	KENWORTH T880 2017 (TAG ALONG) DUMP TRUCK
S2300	KENWORTH T880 QUAD 2017 DUMP TRUCK
S2301	KENWORTH T880 QUAD 2017 DUMP TRUCK

Equipment ID	Equipment Description
S2302	KENWORTH T880 QUAD 2017 DUMP TRUCK
	KENWORTH T880 QUAD 2017 DUMP TRUCK
S2304	KENWORTH T880 QUAD 2017 DUMP TRUCK
S2305	KENWORTH T880 QUAD 2017 DUMP TRUCK
S2306	KENWORTH T880 QUAD 2017 DUMP TRUCK
S2307	KENWORTH T880 QUAD 2017 DUMP TRUCK
S2308	KENWORTH T880 QUAD 2017 DUMP TRUCK
S2309	KENWORTH T880 QUAD 2017 DUMP TRUCK
S240	Ford L9000 Dump Truck
S2400	MACK DUMP TRUCK GU713 2014
S2401	MACK DUMP TRUCK GU713 2014
S2402	MACK DUMP TRUCK GU713 2014 (YELLOW)
S2403	MACK DUMP TRUCK GU713 2014
S2404	MACK DUMP TRUCK GU713 2014
S2405	MACK DUMP TRUCK GU713 2016
S264	1988 KENWORTH T-800 ASPHALT
S265	1988 KENWORTH T-800
S267	1988 KENWORTH T-800
S269	1988 KENWORTH T-800
S271	1988 KENWORTH T-800
T2200	International 960 Roll Off Truck 1995 (CLD 9 966)
T2201	Freightliner 1FV Septic Tank Truck 1997 (CLD 9 963)
T2203	Tank Truck
T2204	WHGM ROLLOFF TRUCK 1992
R227	KOMATSU D61
S4450	Caterpillar D8R DOZER
S4451	CATERPILLAR D9R DOZER 1998
S4458	CAT D4HLX DOZER
S4460	CAT D5M DOZER
S4461	Komatsu D61 EXD w/Advantage Pro Radio
S4500	CATERPILLAR D6RXL
S4501	CATERPILLAR D8T
S4502	CATERPILLAR D6R XL
S4503	CATERPILLAR D8R II
S4504	CATERPILLAR D6RXL (R91) (2003)
S4505	CATERPILLAR D6N Dozer (2010)
S4506	JOHN DEERE 700K
S4507	CATERPILLAR D6R (R116)
S455	CATERPILLAR D8N W/RIPP 1990
S456	CATERPILLAR D8L DOZER 1985
S457	CAT D8R DOZER
S459	CAT D8H
S464	CATERPILLAR D9N DOZER 1993
S467	CATERPILLAR D6H DOZER 1994
S469	CAT. D8H DOZER
R231	Cat 336 Excavator
R249	KOMATSU PC290LC w/Drum Cutter
S407	CATERPILLAR 325BL W/ICE 6E VIBRO
S4109	LINKBELT 290LX
S4110	CATERPILLAR 325 CL 2003
S4111	CATERPILLAR 330C L EXCAVATOR (2003)
S4112	CATERPILLAR 420E
S4113	CATERPILLAR 312C 2005
S4114	CATERPILLAR 420D W/SMALL HAMMER

Equipment ID	Equipment Description
S4115	CATERPILLAR 330DL
S4117	1999 CATERPILLAR 320
S4124	CATERPILLAR 330CL
S4125	CATERPILLAR 325CL (HAMMER)
S4127	LINKBELT 330LX
S4131	CATERPILLAR 330D L Excavator 2007
S4134	CATERPILLAR 320D L 2010
S4136	2008 JOHN DEERE 850DX CE-75
S4139	Caterpillar 336E EXCAVATOR (R117)
S4141	Caterpillar 349F Excavator Total
S4146	Caterpillar 323F Excavator W/Thumb
S4147	CATERPILLAR 325F LCR EXCAVATOR (2017)
S4405	330 CAT EXCAVATOR
S4407	CATERPILLAR 325 CL 2005
S4408	LINKBELT 290LX
T170	2004 OSHKOSH MIXER
T171	OSHKOSH MIXER 2004
T172	OSHKOSH
T173	Oshkosh Mixer
T174	OSHKOSH Mixer 2007
T175	OSHKOSH S-SERIES MIXER 2007
T176	2007 OSHKOSH S-SERIES MIXER
T177	OSHKOSH Mixer 2007
T188	2008 OSHKOSH S-SERIES MIXER
T189	2008 OSHKOSH S-SERIES MIXER
T190	OSHKOSH Mixer 2008
T191	2008 OSHKOSH S-SERIES MIXER
T192	2008 OSHKOSH S-SERIES MIXE2
T193	OSHKOSH Mixer
T194	OSHKOSH Mixer 2007
T195	OSHKOSH Mixer 2007
T196	2004 Oshkosh Mixer
T197	2004 Oshkosh Mixer Truck
T198	2004 Oshkosh Mixer
T199	Oshkosh Mixer 2004
T200	OSHKOSH Mixer 2004
T201	Oshkosh Mixer Front S-SERIES 2005
T202	OSHKOSH MIXER FRONT
T203	2006 Oshkosh Mixer Front Discharge
T204	2004 OSHKOSH MIXER WITH GLIDER
T206	Oshkosh Wrecked Mixer 2008
T207	OSHKOSH Concrete Mixer
T208	Oshkosh Mixer 2014
T209	2014 Oshkosh Mixer
T210	2014 Oshkosh Mixer
T211	2014 Oshkosh Mixer
T212	2016 Terex FD5000 Mixer
T213	2016 Terex FD5000 Mixer
T214	Terex Mixer 2016
T232	Oshkosh S2346 Mixer 2014
T235	OSHKOSH MIXER 2001 (ETC09)
T236	OSHKOSH MIXER 1999 (ETC04)
T237	OSHKOSH FRONT MIXER 2001 (ETC12)
T238	OSHKOSH MIXER 1999 (ETC02)

Equipment ID	Equipment Description
T239	OSHKOSH MIXER 2001 (ETC08)
T247	Oshkosh Mixer S2346 (Trainer Cab) 2018
T248	Oshkosh Mixer S2346 2018
T249	Oshkosh Mixer S2346 2018
T250	OSHKOSH MIXER 2017
R247	Weiler Paver 385B 2017
S561	VOGELE 700 SUPER PAVER
S562	Caterpillar AP555F 8' Paver 2015
S563	Roadtec RP190E RT Paver 2015
S566	Weiler Paver 385B 2017
S569	JERSEY SPREADER Total
S572	BLAW KNOX PAVER PF-3200
S573	BLAW KNOX PAVER PF-3172
S574	BLAW KNOX PAVER PF-3172
S575	BLAW KNOX RE 100 ROAD WIDNER
S577	RoadTec Paver RP-190E 2017
S579	Roadtec SB-2500E Shuttle Buggy
S584	PF180 PAVER 180H
S585	BLAW KNOX WIDNER
S586	ROADTEC RP-170 PAVER
S587	BLAW KNOX PF 161
S589	ROADTEC 2500D SHUTTLE BUGGY
S591	BLAW-KNOX PF161
S593	2005 ROADTEC RP-190 PAVER
S594	ROADTEC RP-190 PAVER 2006
S595	INGERSOLLRAND BLAW KNOX PF3172
S596	ROADTEC 2500D SHUTTLE BUGGY
S597	Roadtec RP190 Paver 2009