A Review on- Construction Equipment Fleet Management in Road Construction

Mr. Yuvraj R. Gawande[1], Prof. Mrs. Nilam Phadtare[2], Prof. Mrs. Smita V. Pataskar[3], Prof.Sudhanshu Pathak[4]

Abstract- *Heavy equipments play a significant role in the growth of infrastructural projects.*

Selecting, managing, and maintaining the equipment asset becomes more complex and costly every day, effective management of these assets directly fuels the success for business by significantly minimizing direct and indirect costs of equipment while still concurrently ensuring high availability of equipment productivity. Realizing the right practices on equipment management and minimizing the problems with respect to management of heavy equipments are dependent on where the machines are in their lifecycle and what the expected efficiency from that equipment.

Keeping the above said context in view this paper work attempts to compile the strategies that go into the planning, management and maintenance of heavy equipments in construction of the road project and also critically examine the practices and problems in handling heavy equipments.

Keywords- Fleet Management, scheduling

I. INTRODUCTION

Construction management is defined as the application of management techniques and systems in construction to complete projects on budget, on schedule, safely, and according to plans and specifications. Construction equipment constitutes a major investment for most construction firms. The basic elements of a Construction equipment policy include equipment costing, replacement analysis, equipment financing, equipment records, equipment standardization, inventory management, maintenance management, and safety. Selection of Fleet Management is not simply about operating the equipment and keeping it working. Fleet Management is very wide in scope and includes the full circle of justification, specification, acquisition, assignment, scheduling, utilization, and disposal.

Thus, by using the fleet management system for mixed construction equipment, construction operations can be planned, managed and monitored better.

A. Aim

To study the Optimization in the resource planning and management which is one of the most important ingredients for competitiveness and profitability in today's construction industry.

B. Objective

- Perform equipment productivity analysis to optimize the current composition of the earth/material moving fleet.
- Perform benefit analysis by comparing the current composition and the recommended theoretical fleet and recommended available fleet
- Recommend changes to the company to assure the optimum level.
- To systemize the complete management of fleet.

C. Need for study

Contractors face increasing demands for shorter schedules and faster project completion. The potential adverse effects of these types of pressures include cost overruns and non-conformance to specifications, as well as other quality issues. Construction equipment plays great significant role in construction industry, costs as high as 36% of the total construction project expense, however, the equipment maintenance has not been given appropriate attention and this contribute to about 40% of total construction project cost overrun.

There is need to study for the proper adopting techniques suited to the situation which is a basic factor for the success and therefore, there is need for rational planning, proper selection, and judicious deployment of equipment in relation to the conditions so as to achieve optimum utilization.

II. PROBLEM STATEMENT

As the most common and typical project types, construction projects have several characteristics such as specific objects: time restraints, cost restraints, special organizational and legal conditions, complexity and systematic Characteristics. For that, each investment project, it is a complex system, especially for the construction project; there are many construction equipments and their complicated

relations, which will influence it. The complicated relations include direct, indirect, obvious, implicit or unpredictable.

The various factors related to the management of the equipments will cause different severity of the consequences. If you do not consider these severe factors at all, or ignore the main factors, they will cause damage because of decision-making errors. Quality targets, time targets, cost targets are the three major objectives of construction project management. Especially in the construction project which needs to handle various range of equipments at various levels.

According to the above description of the background, the risk management of construction period is the management on the time limit in uncertain conditions by efficiently handling the equipment related problems. As the accordance to construction project implementation, the technical and economic analysis is based on the prediction and analysis of the various conditions.

For example, A balance between reliability, investment cost and operating cost should be found since a policy of selecting the lowest priced equipment can often lead to higher life cycle costs..

III. METHODOLOGY OF RESEARCH

As mentioned in the scope of research; the following charted activities are taken into account for study. Steps mentioned below are to be utilized for fleet management analysis. Methodology is broadly divided into the steps as shown below-

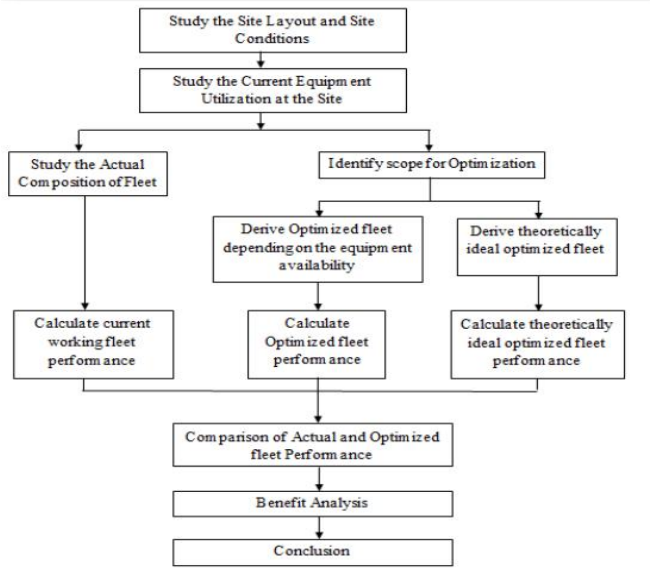

Figure 1. Methodology Chart

IV. THEORY

A. Various Terminologies Used Related to the Equipments

- **Life cycle cost –**

Equipment life cycle cost analysis (LCCA) is typically used as one component of the equipment fleet management process and allows the fleet manager to make equipment repair, replacement, and retention decisions on the basis of a given piece of equipment's economic life. Equipment replacement decisions are critical to the success of public agency fleet management.

If a piece of equipment is not replaced at the end of its economic service life, maintenance, repair, and fuel consumption costs will outweigh the value of its purpose, eating more than its fair share of the agency's limited operations budget.

- **Performance –**

Performance measuring indicators are used to control and improve the utilization of the equipment. The conformance of performance measures by the equipment fleet is proportional to its economic viability. Higher the operational performance of the equipment, the more will be its profitability. In terms of sustainability, the concept of performance provides a robust and a fundamental basis for evaluating a rational procurement. One aspect of the construction equipment procurement is to select an optimum equipment fleet. This factor has seven items which include equipment efficiency, capacity, productivity, reliability, operating life of equipment and its age. These seven items are important in a way that they are essential for effective equipment management practices.

- **System capability –**

The variable loading for the third factor is focused on System capability. It is considered as a spine of an equipment design. It is a barometer for measuring performance, operation and production capability of a typical earthmoving equipment. The better understanding and inclusion of this factor in the selection criteria significantly implies its relevance for smart acquisition practices. This factor uses six items that make up construction equipment. These items are; structure and suspension system, power train system, traction system, implement system, control and information system and machine standardization. The first five items form typical earthmoving equipment whereas the last item i.e. machine standardization represents the utilization of equipment with

the identical components and auxiliaries having similar specifications and characteristics. This practice has certain benefits in terms of lower repair and maintenance cost, high operational efficiency

- **Operational convenience –**

The fourth factor is related to "Operational convenience". It includes six items such as easy repair and maintenance, meet job and operational requirements, spare parts availability, compliance with site operating conditions, versatility of equipment and meet haul road conditions. All these items are considered to be vital for making a decision.

- **Equipment Parts Administration (EPM) –**

Maintenance material costs are related to the frequency and size of the repairs made to the company's equipment. The total number of parts, in addition to the stores' policies, purchasing policies and overall inventory management policies, contribute to the overall maintenance materials costs. Since little attention is paid to maintenance materials in some construction companies, inventory may be higher than necessary. This increases inventory holding costs and make materials unnecessary expensive. Good inventory control enables companies to lower the value of the inventory and continue to maintain a service level of at least 95%. This enables the maintenance department to be responsive to the operations group, while increasing the maintenance department's own personal productivity. EPM helps in knowing the philosophy behind the spare parts inventory, and the mechanisms used in the purchase of these parts. Therefore, there are guidelines for in-house maintenance spare parts stocking decisions and levels which are well understood by all personnel. There is set objective of spare parts inventory turns per year thereby keeping the stock outs of critical parts at the less than 5% level and also the spare parts usage always captured promptly on work orders or requisitions to keep inventory information accurate. Vendor performance are evaluated annually using system information and spare parts storage well organized, cycle counting of spare parts performed regularly and frequencies of counting parts are based on their ABC classification. The cycle counts have a small (less than five percent) variance against system counts. Maintenance purchasing, a centralized efficient activity driven by inventory and scheduled work order requirements is approximately three times per week. The annual contracts are in effect with major suppliers to reduce the purchasing effort. Emergency Purchasing and Expediting is an infrequent activity in the companies.

V. CASE STUDY

A. Project description

Name Of Work : Talegaon Industrial Area Straightening and Repairing of Main Approach Road from NH4 to Mangrul Phata
Client : MIDC, Pune
Name Of Contractor: Shankar Ramchandra Earthmovers Pvt. Ltd. Chakan
Site Location: Pune-Mumbai Old highway(NH4) to Mangrul Phata
Length Of Road: Ch 0.00 to Ch 4650.00 Mtr
Project Cost: 17.05 Cr
Completion Period: 9 Month

B. Equipments Used at Site

- Excavator
- Roller (Single Drum)
- Roller (Double Drum)
- Dumper
- Paver
- Transit Mixer
- Description of Equipments

1. Excavator(Power Shovel)

Excavators (Hydraulic Excavators) are heavy construction equipment consisting of a boom, dipper (or stick), bucket and cab on a rotating platform known as the "house". The house sits atop an undercarriage with tracks or wheels.

2. Vibratory Roller (Single drum)

Road rollers use the weight of the vehicle to compress the surface being rolled (static) or use mechanical advantage (vibrating). Initial compaction of the substrate on a road project is done using a padfoot drum roller, which achieves higher compaction density due to the pads having less surface area surface.

3. Paver

A paver (paver finisher, asphalt finisher, paving machine) is a piece of construction equipment used to lay asphalt on roads, bridges, parking lots and other such places.

4. Dumpers

A dumper is a vehicle designed for carrying bulk material, often on building sites. Dumpers are distinguished

from dump trucks by configuration: a dumper is usually an open 4-wheeled vehicle with the load skip in front of the driver, while a dump truck has its cab in front of the load.

5. Transit mixer

Special concrete transport trucks (in–transit mixers) are made to transport and mix concrete up to the construction site. They can be charged with dry materials and water, with the mixing occurring during transport.

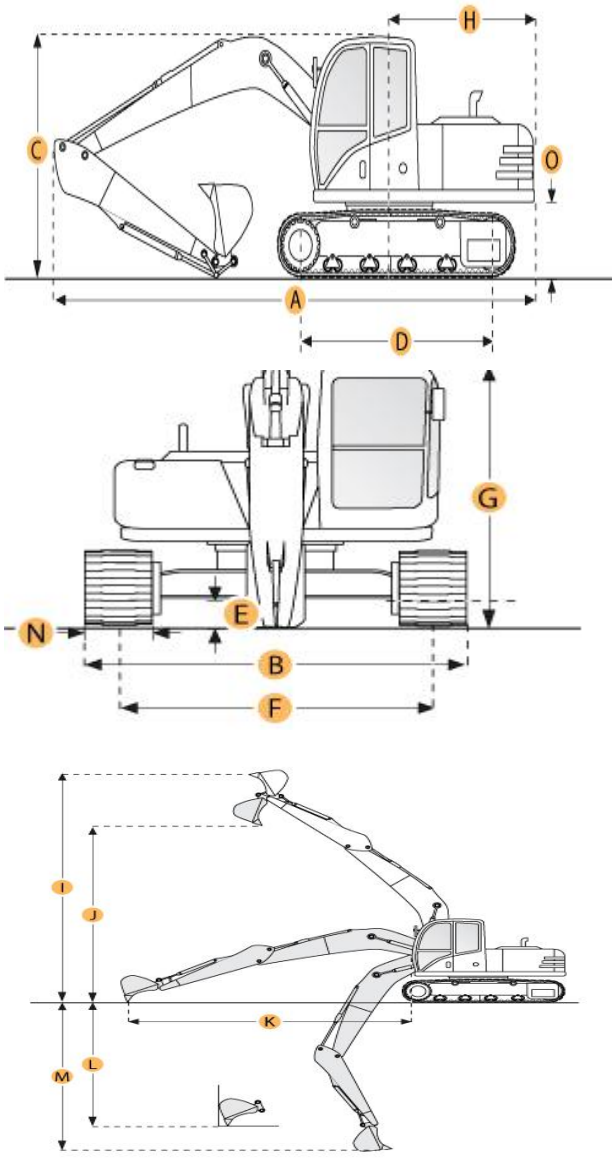

Figure 2. Front and Side Views of Excavator

Table 1. Study of Excavator (Dimensions and Specifications)

Engine		
Make	Isuzu	
Model	A-6BG1T	
Gross Power	132.8 hp	99 kw
Power Measured @	1950 rpm	
Displacement	396.3 cu in	6.5 L
Torque Measured @	1600 rpm	
Max Torque	340 lb ft	461 Nm
Number of Cylinders	6	
Aspiration	Turbocharged	
Operational		
Operating Weight	45305 lb	20550 kg
Fuel Capacity	81.9 gal	310 L
Cooling System Fluid Capacity	10.3 gal	39 L
Hydrauilc System Fluid Capacity	52.8 gal	200 L
Engine Oil Capacity	6.6 gal	25 L
Swing Drive Fluid Capacity	2.2 gal	8.2 L
Operating Voltage	24 V	
Hydraulic System Relief Valve Pressure	4978 psi	34322.1 kPa
Hydraulic Pump Flow Capacity	97.7 gal/min	370 L/min
Swing Mechanism		
Swing Speed	13.9 rpm	
Undercarriage		
Number of Shoes per Side	49	
Shoe Size	23.6 in	600 mm
Number of Carrier Rollers per Side	2	
Number of Track Rollers per Side	8	
Ground Pressure	6.1 psi	42.2 kPa
Max Travel Speed	3.4 mph	5.5 km/h
Track Gauge	7.8 ft in	2390 mm
Buckets		
Reference Bucket Capacity	1.3 yd3	1 m3
Minimum Bucket Capacity	1.2 yd3	0.9 m3
Maximum Bucket Capacity	1.3 yd3	1 m3
Boom/Stick Option (HEX) 1		
Boom/Stick Option (HEX) 1	Boom 5680mm/Stick 2220mm	
Max Digging Depth	19.6 ft in	5980 mm
Max Reach Along	29.8 ft in	9080 mm

Ground		
Max Cutting Height	30.1 ft in	9170 mm
Max Loading Height	21 ft in	6390 mm
Max Vertical Wall Digging Depth	16.9 ft in	5140 mm
Boom/Stick Option (HEX) 2		
Boom/Stick Option (HEX) 2	Boom 5680mm/Stick 2910mm	
Max Digging Depth	21.9 ft in	6670 mm
Max Reach Along Ground	32 ft in	9750 mm
Max Cutting Height	31.5 ft in	9600 mm
Max Loading Height	22.2 ft in	6780 mm
Max Vertical Wall Digging Depth	19.8 ft in	6050 mm
Boom/Stick Option (HEX) 3		
Boom/Stick Option (HEX) 3	Boom 5680mm/Stick 4410mm	
Max Digging Depth	26.8 ft in	8160 mm
Max Reach Along Ground	36.4 ft in	11100 mm
Max Cutting Height	33.5 ft in	10220 mm
Max Loading Height	24.3 ft in	7410 mm
Max Vertical Wall Digging Depth	24.7 ft in	7540 mm
Dimensions		
Width to Outside of Tracks	9.8 ft in	2990 mm
Height to Top of Cab	9.4 ft in	2870 mm
Ground Clearance	1.5 ft in	450 mm
Counterweight Clearance	3.4 ft in	1030 mm
Tail Swing Radius	8.9 ft in	2720 mm
Length of Track on Ground	12 ft in	3660 Mm

VI. CONCLUSION

Construction has been going on for centuries, in some form or the other. The construction in early days was very primitive in method. Since money was not in short supply, there were no cost considerations in construction. The buildings and infrastructure were grossly over safe. In early part of this century, the British started developing some infrastructure in India and for the first time a scientific approach was applied to construction. But it remained pre-determinately labor oriented and the importance of heavy equipment was not felt. With the advent of new needs for construction like industrial structures, large multi-purpose projects, the methods employed became more complex. At this time a need for heavy equipment was felt which would perform the work faster and with greater accuracy.

REFERENCES

[1] S.C. Chand_2011. "Construction Equipment and its Managements". Khanna publishers.

[2] Peurifoy, Schexnayder, Shapira_2012. " Construction Planning, Equipment, and Methaods".TataMcGraw-Hill Edition

[3] M. waris, Mohd. Shahir Liew, Mohd. Faris Khamidi, Arazi Idrus. _2014_. "Criteria for the selection of sustainable onsite construction equipment." ScienceDirect., 3_96_110.

[4] Rudolf Kampf, Ondrej Stopka, Iveta Kubasakova, Vladislav Zitricky. _2016_. "Macroeconomics Evaluation Of Projects Regarding the Traffic Construction and Equipment." ScienceDirect, Precedia Engineering, WMCAUS

[5] G.E. Gürcanlı, S. Baradan , M. Uzun. ~2014_ "Risk perception of construction equipment operators on construction sites of Turkey". ScienceDirect, IJIE .

[6] Jungho Yoon, Jeonghwan Kim, Jongwon Seo, Sangwook Suh._2014" Spatial factors affecting the loading efficiency of excavator ". ScienceDirect, Automation In Construction.

[7] Tsado, Theophilus Yisa ,Theophilus Yisa Tsado_2014_Volume 3issue4 "Equipment Maintenance: An Effective Aspect Of Enhancing Construction Proje Profitability"ijsei.