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Cost Analysis and Productivity of Excavator, Bulldozer, Tipper Truck with using Fleet Management

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Abstract: The gigantic growth in Indian construction and development sector have been observed at the start of 21st century. Due to rapid development in engineering and technology numerous mechanical equipment has been utilized from micro to macro level infrastructural projects like industrial, roads and bridges, multi-storey steel structures etc. The following research is made for finding out cost-effectiveness and fecundity of heave and excavating mechanical equipment based on there use on different site locations by mean of proper modelling and cost analysis furthermore testing of computer software on the basis of there productivity. The research tends to focus on spontaneity in designing the software based fleet management technique of tool managing on different field of construction so that optimal results can be achieved through them. These advance system includes tool to be implemented with a code which is verified by the system then an algorithmic calculation is made by software to provide best available solution on site resulting in ease in decision making and reducing the time requirement and making it cost effective.

Keywords: Hauling and excavating tools, software, Fleet management, Optimization, Productivity, Decision making, Cost-Effectiveness

I. INTRODUCTION

Primary cost assessment and technical planning is key to achieve an optimum results assessed before start of any project this process is called the planning and estimation. Use of various technology and computer based software can be way to do so. equipment management plays a lead role for getting such optimal results that includes productivity and efficiency of such tools. Even though marginal and average cost is available the proper calculation is difficult. Unit cost of various on field operations vary from scale of work i.e Macro or Micro for excavation or dumping of earthen materials. But in such operation the overhead cost shall always remain fixed which includes transport of tools and surcharge-cost, generally total equipment cost is summation of overhead or indirect cost, operational expenses and man-power cost. But for some survey manpower charges could be excluded from total tool rates thus analysis is carried on only indirect and operational cost in such work man-power cost is calculated separately as the fact that actual labour hours can vary from equipment operational hours. But in the following research manpower cost are encompassed with the indirect and operational cost so that possible criteria affecting the total cost of ownership and its operational charges could be calculated on hourly basis with 50 to 60 minutes performance rate when tool being used at its full capacity, Also previously researched sector of optimum profit by T.Saikumar here life cycle cost and decision making techniques being studied and compared in following research

II. METHODOLOGY

A. Data

The Primary information for the following research is gathered from Mumbai airport development in Maharashtra various factors like cost price, operational charges and skilled labour charges are taken into consideration with the help of holder and merchant distributor of such equipment along with this data, efficiency of tools like carrying capacity of hoes, lead speed of tools are gathered by scrutinising the operation on construction of airport

B. Methodology for Ownership cost and Operational charges per hour (O&O cost)

Followings are steps involved in the determining ownership cost

- 1) Information is gathered from merchant distributor involves the life span of equipment in working hours and efficiency of equipment, taxes and surcharges, annual insurances to be paid by owner are gathered from maker like L&T, Caterpillar etc. in accordance with IS11590:1995
 - 2) Computing the net expenditure made on tools maintenance which is the contrast between the Price and residual value
- Computing the hourly charges which leads to net value can be calculated as follow

Cost per hour to cover net value =

Purchasing price (P) – Residual price (R) / Life of equipment in hour (L)

C. Steps for Calculating Owners Cost

The primary information from holders and contractor about operating cost of instrument which includes fuel cost per unit hours, amenity charges and monthly wages of operator are collected by scrutinising the sangrur highway project the working hour of 8 hour are considered

The maintenance cost of equipment including oiling, tyres or tracks maintenance are obtained with reference to IS11590:1995 and owners manual in unit hours and it is assumed as C2

Thus summation of these cost gives us total operating cost and owning costas (C1+C2)

D. Methodology Adopted for unit Hour Productivity

Technique and approach in the research has been adopted from the R.L Peurifoy’s book named as Construction Planning, Equipment and Methods of 7th edition

E. Performance of Equipment

It is defined as the ratio of (operational +Owners) cost to the productivity of equipment , its nothing but cost of running single unit productive equipment in rupees

F. Results Validation

The result from O&O cost quoted which is obtained from observation are to be thoroughly compared with 2014 schedule of rates for delhi provided by Central Work Department (CWD) thus, Output from equipment of efficiency of 50-60 of unit hours which is obtained from merchants and holders are to be juxtapose with pre calculated values

III. RESULTS AND DISCUSSION

A. Data of Owning Cost and Operational Cost

The following tables shows the cost of owning the equipment , maintenance cost ,surcharge charges like annual insurances and permits assumed as 20% of gross value. This also includes the monthly wages of operating person by assuming the daily work of 8 hours ,fuel consumption price unit hour considering equipment efficiency of 50-60 minutes as its optimum efficiency per unit hour Assume Diesel price of 50rs/lit and electricity charges of 10rs per Kwhr

TABLE I
O&O COMPARISON

Sr. No	Tool name	Purchasing Cost in rupees	Monthly Maintenance in rupees	Per Hour Fuel (Ltr)
1	Excavator	0.56 crore	20,500	12 – 15
2	Buldozer	1.1 Crore	30,000	24 – 30
3	Dumping Truck	0.32 Crore	14,000	10 – 12

TABLE III
Operational cost

Sr. No	Equipment	Monthly Operators Wages (Rs.)	Per Hour cost for insurance and taxes Rs.	Life in Year & Hours by IS11590:1995
1	Excavator	18,000	470	10 -12,000
2	Buldozer	22,000	550	10 – 30,000
3	Dumping Truck	16,000	210	8 – 16,000

B. Results for O & O Price

The observed values obtained from unit hour O&O price with the help of the data obtained is interpreted is shown in the result table as follows.

TABLE III

Sr . No	Equipment	Per Hour Owner & Operation Cost
1	Excavator	2,150
2	Bulldozer	2,550
3	Tipper Truck	1,650

C. Productivity Results

1) *Excavator:* For excavator or back hoe loader with capacity of digging as 1.5 cubic.m with filling factor as 0.8 and having cycle period of 30 second i.e. digging, swinging arm and dumping and repeat the rate of production can be calculated as follow

$$\text{Production Rate} = (3600 \times 1.5 \times 0.8 / 30) \times (50 / 60) = 120 \text{ cubic.m/hr}$$

Thus excavator digs a 120cumec of ground in unit hour with efficiency of 50 minutes

2) *Bull Dozer:* Bull dozer is machine which is combination of tractor and loader unit it have sharpe blades at front side which act as both loader as well as scrapper but now a days such unit comes with some small back hoe arm unit , such machinery have the power unit in between 200-300 BHP. these heavy machinery scraps the surface at maximum speed of 5kmph bull dozer are equipped with track system which have more surface area as compared to regular tyre type. Thus providing ease in movement of machine marshy land and swiftly cutting landmass

3) *Output from Bull Dozer:* Power Output of Dozer in cumec per unit hour = hard or soft soil strata handled per trip X S X 60/tonne X efficiency%

Where,

S= Swelling factor

T= Cycling time for each tripe in minutes

4) *Dumping Truck:* It is a mechanical unit to transport the earthen material from two points, the load carrying capacity of such unit is 10 cubic meter. If filled by using back-hoe loader of 1.5cumec capacity needs around 3-4 minutes at 90% of its capacity time of transportation depends on speed of truck usually its 30kmph thus to travel distance upto 8km requires time of 12-15 minutes after words, hydraulically operated system of dumping needs 3 minutes to unload. Thus cycle time of dumping truck from dig-site to dump-site is 20-22 minutes. Concluding the efficiency of dump truck of 50 min per unit hour is found out to be 26.5 to 30.5 Cubic meter

D. Fleet Management

The responsible person for the fleet management is called fleet manager and to maintaining the good condition of equipment under his vision is his primary duty, maintaining a good service so that optimum output or efficiency can be achieved through the machinery is also considered as the managers duty. Apart from this thing he is responsible for periodic checkups and report of efficiency of equipment over the time.

He also tends to plane and coordinate instruction in regarding to buying of new tools, its life span and achievement of desired efficiency through structured coordination of sub-ordinates such as operators skills, fuel economy etc by means of computer system example of such software is TN360

E. Fleet managing Software and Digitalization

Due to the fact of industrialization and development in computer appliances fleet management has become very effortless as many software are started to developed on different platforms like IOS,mobile phones and computers. Such software has particular goal of digitalization of hectic field task and ease them following are the key feature of such softwares

1) *Planning of Maintenance:* Such system tends to schedule the periodic checkups and maintenance of equipment reducing the overwork of tools and thus helping fleet manager for limiting the overburden on equipment and make it easy to spot minute problem which could hurdle the major task in future thus reducing delays or in-operations of equipment.

2) *Digital Vehicle Inspection Reports:* Digital Vehicle Inspection reports or simply DVIR enables one to simple report the problem of tool rapidly and get assistance in resolving the issue in real time. while physically reporting the problem may be hectic and time consuming and cause time delay. In DVIR one can simply take picture and directly report to fleet management.

- 3) *Consign or Work Management*: Digitalization in work management enable the workflow with minimum error. Such system enable to allot daily tasks and work chart, So that all work flow could be monitored by fleet management allowing automated consumer interaction by simply taking picture and signature of delivered good.
- 4) *Electronic Logging System*: For getting instantaneous position of working personal ELS system can be utilized ensuring safety of good and tracing accurate working periods of related work thus insuring the continuous work flow.
- 5) *Safety of Driving Personals*: Fleet management software enables the safety of good as well as the driver by system of tracking system manager can trace the unsafe and risky driving skills of driving personals such identified person can be trained further under the expertise guidance programme. Such system helps in creating drivers profile based on there personal skills eliminating the set-downs in transportation. So that all the working structure pyramid comes under the vision of managing authorities ensuring hurdle free work system as all real time data can be automatically transferred to control rooms thus ensuring safety and security of drivers.

F. Reason Behind using Fleet management software

Fleet management software offers many benefits including fleet location and performance, cost analysis and improved real- time visibility in the driver class. Modern agile management software goes beyond tracking location by presenting data in a way that businesses can easily understand, with insights into vehicle performance and functionality. Fleet managing tools can assist you get intent data on drivers Security and safety, highlighting dangerous methods such as over speeding or hard braking and bolding person who need more training and interpretation. It is also inseparable that its agility will comply with federal and state legislation, especially ELD, DVIR and IFTA. The system also helps in maintaining physical condition of equipment thus insuring less hurdle with smooth workflow scheduling monthly check ups and reducing of equipment broke ups. Due to digitalization it give instantaneous solution over problem in real time by just use of portable devices.

G. Role of fleet Manager in Fleet Management Tool

As an fleet manager its an absolute duty to ensure all data of system has been store all data on cloud based AI system. Cloud system are the system which stores all data in virtual storage unit rather than the usual physical unit which has danger of getting lost or getting corrupted while in cloud based storage unit one's data can be assessed at any time and has no chance getting lost as all the data can be transferred in any device at any location. As a fleet manager one should locate the following key element in any system , are given bellow

- 1) *Tool for Automation*: The system should alert the higher authority when there is change route or aggressive driving is observed it also includes automated customer alerts
- 2) *Data Perception*: As all data output sometime may complex to understand one should be able to understand and intercept the output and it have AI assistance to ease the process
- 3) *Safety Analysis*: Safety and security is main feature of fleet management as one can easily able to locate the particular unit in real time for smooth workflow
- 4) *Assessment of Performance*: Assessing the efficiency of the units plays vital role in cost-effectiveness of over all work thus if particular section or part of system is lagging behind then its important assess the problem and to counteract it for optimum efficiency.

H. Working of Fleet Management Software

Such software work in array of collecting the data, uploading to cloud based platform and eventually providing the simplified structured data to the user. System uses the Global Positioning System to trace its assets in particular location provided in form of coordinates tracing involves speed of unit, estimated time of delivery and alerts user when direction of unit changes from assigned one. Each unit is fitted with Camera, A specially generated tag and scanning system.

- 1) *Cost of Software*: Operating cost of using such software depends on number of assets the organization holds and size of network desired but almost every telecom company offering such services uses Saas model i.e. they charges annually or bimonthly for there service
- 2) *Key Performance Indicator in Fleet Managing*: Key performance indicator is vital part to control the bulging of total expenditure as estimated , It also related to fuel efficiency per kilometre or concerned units. It also help in keeping data of driving personal and ensuring the safety and security of them

- 3) *Software to comply with Electronic Logging Device:* Fleet managing apps keeps all the data which is output from electronic device installed in vehicle units in binary forms on virtual cloud platforms. Such data includes the vehicle entry or exit time , real time location of each unit, opted track.
- 4) *Keeping Track of Maintenance Cost:* As it is very essential to keep machinery at well condition, it is also important to keep the cost of fixing the tools to minimum as it can be important to calculate effective price. It also keeps the track of replacement of any out dated part of equipment that to be replaced thus using the maximum efficiency out of life span of tool.
- 5) *Scheduling of Maintenance:* Fleet managing software keeps update of timely repair of any broken vehicles and scheduling maintenance checks periodically thus keeping the wear and tear of equipment at minimum.

TABLE IV
Productivity Table

Sr. No.	Type of Equipment	Normal Productivity	Fleet Productivity	% Increase in Productivity
1	Excavator	120	168.024	40.02
2	Bull Dozer	44.81	53.48	19.35
3	Dumping Truck	26.55	34.12	28.52

IV. CONCLUSIONS

From the above research we can conclude the following key points

- A. For both the situation spectrum of optimization occurred
- B. Complete investigation of efficiency per hour and there contrast denotes that relative value of holding fleet has maximum efficiency after optimization the concerned rate of production for case A, B, and C are 40.2 %, 19.35% and 28.52% respectively.

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