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To Study Improvement in Construction Industry Due to Machineries and Advanced Technological Machineries

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ABSTRACT: Construction machines are the part of the industry which helped every sector of the industry with its ability of performing at its optimal level at any possible conditions. It eliminates the drawback of the shortage of labour on site on unexpected situation. When equipment performs more than the expectation then it boosts the industry to adopt more machineries for various projects. While working on site conditions, requirement of various different machines arises which is also solved by various types of construction equipment available in market. Since working with machines, many industries and companies came with very advanced technological machines which performs more faster and easier as compared to old machines. Construction industry is growing in rapid speed and one of the main components of this industry is machines, which should be given more attention for improvement. The massive growing demand of heavy construction equipment in countries such as China and India are major, which is to be expected in increase the demand in the region during the forecast period.

KEYWORDS: Construction equipment, advanced construction machineries, improvement in construction industry.

I. INTRODUCTION

Heavy construction machineries are operated to minimize the need of manpower and increase the speed and efficiency of the project and to reduce the time bounding of project requirement. These machineries are used in various industrial fields such as oil & gas, military, mining and agriculture & forestry and mainly in construction industry. The demand of these heavy machineries is growing rapidly in infrastructure industry, commercial buildings and skyscrapers. More involvement of public in private sector, interests in real estate field helped the market to grow in massive percentage. Government is getting more involved in development of infrastructure and increasing of partnerships in construction of public infrastructure are growing more. Government is more investing in the development of buildings, roads, power stations, bridges, etc which requires more use of heavy equipment and machineries.

These all machineries are based and classified on the various types of heavy construction equipment as earthmoving equipment, material handling equipment, heavy construction vehicles and other heavy construction equipment.

The heavy construction industry has been grown so far, based on region into North America, Asia-Pacific, Europe, South America, and the Middle East & Africa. Asia-Pacific held the largest share in 2018. It is expected the dominance of Asia-Pacific until 2027.

Demand from customer for reliability of construction equipment is increasing. Reliability of machine is obtained or determined firstly from adequate design and next from capability of manufacturing in executing the design. The major reliability factor for customer is performance of machine. Discussion about the good and bad points of machine and reliability should be discussed as it will be helped to make corrections and improvement of machine with the help of suggestions. This can be achieved effectively with the use of reliability organization, and with the final approval the products are shipped.

Industry growing older still shows remarkable growth in the heavy construction equipment. Global demand for the results of this industry is still growing at about 6% per year. After getting relaxed from financial crises continents like Asia, Russia etc are sharing the worldwide drive to grow more by construction new projects and renewing older projects in public and private sector for development. Heavy construction equipment consists of some major product

categories such as: highway trucks and tractors, loaders, graders and rollers, cranes and draglines, mixers and pavers, hoists and winches etc.

II. RELATED WORK

David Arditi[1], Serdar Kale[2] and Martino Tangkar[3] indicate that the rate of innovation in the construction equipment industry increased in the 30-year study period and also suggest that these innovations are incremental in nature, stimulated by technological advances in other industries, but primarily driven by market forces. Technological advances are not confined to the industry that produces innovations. The mapping of the inter-industry flow of innovations highlights that while construction companies play a prominent role in generating their own technological innovations.

Mr. Nilesh D. Chinchore[1] and Prof. Pranay R. Khare[2] states that equipment improves quality, productivity and safety. Construction equipment planning aims at identifying construction equipment for executing project tasks, assessing equipment performance capability, forecasting date wise requirement of number and type of equipment and finally participating in the selection of equipment to be acquired. To derive full benefits from the equipment, there should be proper selection and good planning of its operations. This paper deals with the planning and selection procedure for equipment adopted by a company to achieve its objective of timely project completion.[10]

Gransberg et al.[1] stated that industrial and heavy construction projects required intense and high utilization of machinery for carrying out mass excavation, stabilizing, compacting, asphalt paving and finishing, pipelines railroads and many other special activities.[12]

Prajeesh. V. P, Mr. N. Sakthivel states this thesis is to study the management of equipments practices in Construction Industry and to present the most popular practices of the contractors and to compare the equipment management policies with a Case study of a construction industry. The needed data were collected via a structured questionnaire. The contractors were divided into three grades based on their annual work volumes. The collected data were analysed using the SPSS software. The elements of the management policies were cross-tabulated against the grades of contractors for finding possible significant differences in contractors' practices. Hypotheses on some expected results were tested.[7]

Tavakoli et al.[1] described that equipment productivity is a key factor that enables contractors to make a decision regarding the project scheduling, fleet selection, and project costs. Most contractors rely on their historical data and previous projects to obtain the productivity of selected equipment.[18]

Amirkhanian et al.[1] developed an expert system model for equipment selection in earthmoving operations. As part of developing the expert system, a rule-based expert system was used for selecting earthmoving equipment. The system was developed to interpret data pertaining to soil conditions, operator performance, and volume required for the earthmoving operations.[19]

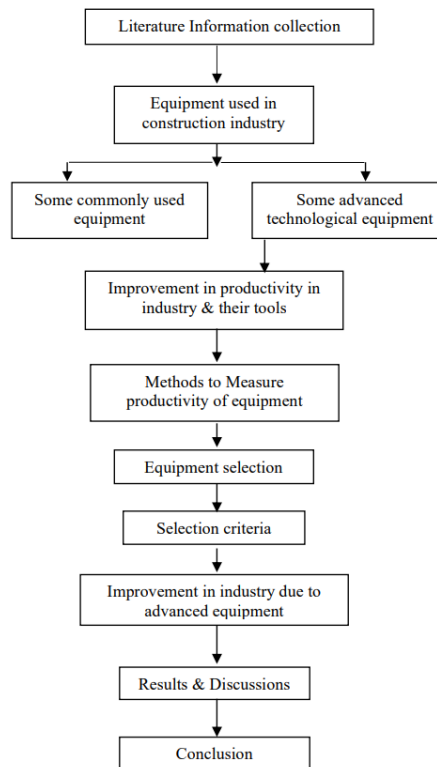
Omer Tatari[1] and Miroslaw Skibniewski[2] stated that Effective management of equipment is crucial for the success of construction firms. Inadequate manual processes of equipment management and the subjective decisions of equipment managers usually result in major losses in construction firms, hence, the economy. The main purpose of this paper is to introduce an agent-based equipment management system aiming to increase integration and automation, and to minimize decision errors. Recent research on agent technology allows the proposition of an automated and integrated application for equipment management. The proposed application makes use of the current databases of the firm and adds wireless technology to construction equipment for automated data integration.[8]

Miquel Casals[1], Nuria Forcada[2], Xavier Roca[3], states that present pressures from governments and other institutional agencies as well as general conscience are forcing the construction industry to further adopt safety and environmental aspects in their normal way of functioning, and so every activity or process that a company carries out has to be rethought in order to achieve this integration of other parameters. The aim of this paper is to present the results of a research project for creating a methodology to select construction equipment,



combining the use of several well known methods for each of the aspects involved in the selection and using the multi-criteria analysis to reach at the final choice or recommendation.[9]

III. METHODOLOGY



A. Equipment used in construction industry:

I. Most common construction machineries associated in major projects are:

1) **Tower Cranes:** A tower crane is a machine which is used for lifting materials from one place to another. It has a winder (also known as drum), wire ropes or chains and sheave to lift up and to lower down and to move them in a horizontal manner. It is included with one or more machines which produces the mechanical power for movement of heavy loads which is not possible for human physical capability. Cranes are generally used in transportation industry for loading and unloading of heavy loads, container and etc. It is mostly used in construction industry and generally in tall buildings and also in manufacturing industry for assembling of various heavy machines and equipment.

- **Types of tower cranes are as follows:**

- Hammered tower crane
- Self-erecting tower crane
- luffing jib tower crane

2) **Construction Hoists:** Hoists are used on the construction sites for vertical transportation purpose, transporting materials and passengers from bottom to top level. These machines are mainly powered by diesel engines or an electric motor that rotate the lift wheel around the wire rope which is wound. Hoists are also hydraulically driven which can use chains as a lifting mechanism instead of wire ropes. Hoists and cranes differ from each other as cranes moves the items and weights vertically and horizontally and while hoists lift anything only is vertical direction. It is mainly used in industrial purposes and are not accessible for public purpose.

- **Types of Construction Hoists are as follows:**

- High Speed Hoists
- Common Towers
- Twin Capability

II. **Advanced equipment used in construction industry:** The introduction of new mechanized equipment in construction industry gave effect on the cost of project and as well as the productivity of construction and the methods and system used for construction itself. As an example, one of the innovations which is the introduction of computer microprocessors on tools and equipment is perfect to be given. As the result of this innovation, the performance and the tasks of the equipment can be continuously monitored and can be adjusted as per the requirement for improvement. In various cases, automation with the least or small part of the process is possible and desirable. On grading work of projects, laser-controlled scrapers can produce required cuts faster and more accurate than compared to manual methods. Possibilities of automation and robotics entering full in construction is getting more and more as innovations are coming in existence. These driverless machines use sensors, drones and GPS for navigation on the construction site and perform sitework based on the 3D models of the ground terrain to accurately excavate and grade the purposed work. Augmented GPS, a combination of base stations and satellites, are used to fence the site and allow autonomous equipment to move around the site with more accuracy. The benefit of using technology like robots, autonomous or self-controlled equipment are in to ways. First way, in future years, workers entering inside the worksite will be having tablets and smartphones and using for lifetime period, so operating of the machines with these operating devices will become more easier to operate. And second is the younger workers which are going to be working on new sites will be using technology to perform their jobs, there will be less use of human power for achieving any goals and getting better results.

B. **Improvement in productivity in industry & their tools:** In previous some decades, the growth in construction industry is in massive percentage. The government is mainly focusing on the development of Infrastructure by constructing roads, power plants, airports and other projects. The growth of Information technology has also needed to be transformed into new technologies as Hitech facilities for the Engineers and construction of software parks and other such projects have also taken into importance. The growth percentage maintained by the government in last years has also increased the quality of the life of any general human being and therefore, to boost these quality shopping malls, educational institutions with modern teaching gadgets and new technology are also being introduced across the country. Various changes have come into the residential buildings' construction, as the need for raw materials are possible by increasing more multi-dimensional factories. Then the other important factor which is time, is also significantly reduced by massive speed of construction.

Every project is a unique product with a definite start and finish. Project is a activity on which massive amount of money is invested in the form of labour, equipment, materials and etc in the result of profits. Most of the construction projects are difficult in nature by technical point of view. Due to this such projects need experts with knowledge in various sectors and more attention to the whole process. Projects require huge input at initial stage of materials, machineries and manpower. While materials are about 40% – 65% of the project costs as per the standards and specifications of the projects and quality of materials are achieved by scientific methods and codes.

Management of productivity follows some following practices to improve in project and equipment:

- Management of productivity is main aspect of project which also includes planning, safety, quality, time etc are also given same importance. When productivity is focused then everything comes under control and space for improvement from top to the bottom of the body of project, and therefore improvement in productivity increases.
- Incentives should be given to the equipment operators and staff members for resulting in increase in productivity in the entire work site. Some team leaders should also get incentives for managing the whole team and work with small observation.
- A team has to be selected to monitor, and to observe productivity of project. The team should be included with managers and supervisors.
- The effect on the profit margins and the objectives of project due to productivity or lack of productivity should be examined. This information gives brief knowledge of requirement of improvement.

C. Methods to Measure productivity of equipment

Productivity which plays very vital role in construction process then there are three important points while increasing productivity:

- a. Task Level
- b. Project Level
- c. Industry Level

The task level productivity of any equipment and manpower helps in direct increase in efficiency for each operation and task which is to be performed at any construction project and hence productivity in task level is measured for gauging project efficiency. Some following methods are used for reaching towards task productivity.

- a. RS MEANS METHOD
- b. CII METHOD
- c. PRODUCTIVITY INDEX METHOD

o **RS Means Method:**

In this particular method, the number of hours linked with a designated crew day is at denominator. Therefore, designated crew day higher output is always better. So, then the higher output is equated to the higher task labour. In such cases, this method provides estimation of output that is produced by crew in 8-hour day with the equipment they use and these measures can be taken as multi factor.

o **CII Method:**

The CII method of benchmarking and metrics program used different type of metric to calculate productivity of task labour. This method fixes the output produced and measures the hours of labour required to generate that output. In this method, numerator is number of labour hours and denominator is fixed output. Thus, for given amount of output, lower labour hours are better which is later equated to the high task productivity.

o **Productivity Index Method:**

A task productivity index is a dimensionless number, which is pegged to a reference set of data in which the set of data denotes the base line value for one or more components of the index. As an example, denominator can cross to the baseline value for the task labour productivity and the numerator can be the value for project.

Project and industry level productivity are measured by overall efficiency of project and the industry level is itself are macro level observations which requires a separate set of detailing and analysis of data.

D. Equipment Selection: While preparing for pre planning construction process, selection of equipment is important step to be taken in consideration. There are various factors for selection of equipment for construction process. There are some factors mentioned below:

- The equipment should be of standard quality equipment.
- Equipment should give best results at low cost
- Moderate unit cost
- Equipment should be easily accessible to repair and maintenance work.
- It should fit for the requirement of operations to be done.
- The equipment should be capable of doing more operation and functions instead of one.
- Low working cost and moderate size.

Construction equipment is the best factor that a company can fully depend on for results. This equipment provides the best results when company is working against a deadline. Some of the common construction equipment for any small or large projects includes backhoes, pavers, excavators, tractors, rollers, trucks, welders, wheel loaders, bulldozers, generators and etc.

Most often, excavation of a piece of land of construction site is the initial process of any kind of construction. This process clears off the site space and clears the planning of placement of foundation and basement of a construction project. Excavation with manpower is quite possible but not in every project as it needs more



workforce and takes a lot of time only for excavation work. Therefore, most of the construction firms and contractors rely on excavation machines for clearing and digging of site in short amount of time. Excavation equipment reduces manual labour and can work in limited amount of time. These machines come with some necessary attachments and tools to perform their functions perfectly and one of the major tools and attachment is the excavator bucket. This bucket tool is major part to perform the work properly and efficiently.

E. Selection Criteria: Site conditions of ground and soil take part in major factors of selection; the conditions affect the selection of equipment. As the soil conditions show whether to choose crawler or any equipment which will not get struck in any obstruction. Any equipment which needs any power supply should be chosen as per the conditions of site regarding power supply availability.

- **TYPES OF EQUIPMENT**

- a. Earthwork Equipment
- b. Concreting Equipment

- a. **Selection Criteria for Earthwork Equipment**

- Capacity of equipment to move materials in one take and quantities to be moved on site.
- Time management for completing particular task or job on site.
- Soil condition and compaction factors, etc.
- The conditions of job included various factors such as space availability of loading and unloading, access of site, weather conditions.
- Number of earthmoving equipment are planned from following criteria:

- b. **Selection Criteria for Concreting Equipment**

- Site conditions according to the limitations and restrictions.
- Availability of equipment machines or local management of equipment.
- Operation schedule, weather conditions of site, work nature such as temporary or permanent kind of work, time boundaries and specifications of concrete.

F. Improvement in industry due to advanced equipment

The management of equipment and policies should always have great impact on the profitability of the contractor with the investment in the construction equipment. In civil projects, the cost of machineries varies from 25-40% of the total cost of project. To study about the importance of proper planning of equipment and their maintenance is important in every project. The main reason of understanding this study is to evaluate the total traffic flow of equipment which influences the efficiency of work operations.

Technological improvement is the need of every industry and sector and this is also for the Construction equipment industry to advance with time. While in the earlier time, construction equipment is continuously focusing on advancement of machine but still there is more a lot to do in this sector which will benefit in new future coming with more advancement.

Globally, India has grown as one of the key potential markets for construction equipment and machineries. Further, it is estimated that by year of 2025, India will be third largest in the world in construction market which will be beneficial for India and will exhibit massive demand for equipment with new technology and advantages offered by them.

G. Experimental results:

Mode of work	Capacity (m3/day)
Labour (works 8 hrs per day)	10 m3/day
Hydraulic excavator	242.4242 m3/day



Figure 1: Concrete pump, Ayush Procon Pvt. Ltd.
Nagpur- Mumbai Highway, Tighre, Jalgaon

IV. CONCLUSION

1. The study explains that the various types of machines work in construction industry have great impact on the projects and industry. Major role is played by cost of the equipment, and secondly the size of the projects which differs the type of machine in size and working abilities.
2. From the study one point came into notice that as the industry is growing, advancement of machines is growing too.
3. Selection of equipment is a critical factor while working on big project, because the whole time, cost, quality of work is mostly dependent on the choice of equipment and their abilities.
4. Appropriate knowledge and experience of working with equipment can save money and time.
5. Dependency upon labour is 90% minimized due to advanced equipment and remaining 10% will also get minimized in coming advance years.

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