A computer based approach for Material, Manpower and Equipment managementin the Construction Projects

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Abstract. The success of any construction project will depend on efficient management of resources in a perfect manner to complete the project with a reasonable budget and time and the quality cannot be compromised. The efficient and timely procurement of material, deployment of adequate labor at correct time and mobilization of machinery lacking in time, all of them causes delay, lack of quality and finally affect the project cost. It is known factor that Project cost can be controlled by taking corrective actions on mobilization of resources at a right time. This research focuses on integration of management systems with the computer to generate the model which uses OOM data structure which decides to include automatic commodity code generation, automatic takeoff execution, intelligent purchase order generation, and components of design and schedule integration to overcome the problems of stock out. To overcome the problem in equipment management system inventory management module is suggested and the data set of equipment registration number, equipment number, description, date of purchase, manufacturer, equipment price, market value, life of equipment, production data of the equipment which includes equipment number, date, name of the job, hourly rate, insurance, depreciation cost of the equipment, taxes, storage cost , interest, oil, grease, and fuel consumption, etc. is analyzed and the decision support systems to overcome the problem arising out improper management is generated. The problem on labor is managed using scheduling, Strategic management of human resources. From the generated support systems tool, the resources are mobilized at a right time and help the project manager to finish project in time and thereby save the abnormal project cost and also provides the percentage that can be improved and also research focuses on determining the percentage of delays that are caused by lack of management of materials, manpower and machinery in different types of projects and how the percentage various from project to project.

1. Introduction

Construction management is the management of construction techniques for completing projects within estimated budget, time and according to plans and specifications without compromising the quality and safety[5].The improvement in the microcomputers, computer hardware and software,because of their low costs have made use of computers in various fields of construction management like project management, cost reducing,scheduling, bid analysis, accounting and financing,management of materials, equipment and manapower.

Materials management is a system that is essential in controlling and planning the quantity &quality of the material, fair price and the right quantity as required and also it includes purchasing, material and shippingcontrol from suppliers which is required for material cost control[4]. Three essential phases that leads to advantageous materials management are materials purchasing, materials usage, and storage.

When we consider any project equipment is a major cost for construction firms. The equipment management system andcontractor's equipment policy will have a great influence on the profit of the organization, mainly for contractors because of more amount of investments in equipment. The components of a construction equipment policy mainly consists of cost of the equipment, equipment financing, timely replacement of equipment's components or equipment, equipment standardization, records of the equipment, safety , inventory, and maintenance management,. A suitable approach in equipment management system is FLEET, which can supplement the contractor's equipment policy and which results in productive and effective utilization of equipment and more profitability. Fleet consists of four units: (1) Inventory management unit; (2) maintenance management unit; (3) cost, time, and production records unit; and (4) report generator unit[5].

The dominating factor is, the influence of labor and their cost on total project costs. For the past decades labor has been a inexpensive commodity which is a primary solution to quality and schedule problems by increasing the size of the work force. Strategic planning is a process in which the objectivesof an organization are identified and developed and appropriate actions are taken to meet the identified objectives. In this process resources are allocated for carryingout actions. The process will begin with the identifying organization's mission, objectives and formulationg the strategieswhich will result in the attainment of identified objectives and for implementing these strategies action plans with short-term goals and targets should be taken. Tier II approach is future oriented approach, which is designed for improving workers' productivity, skills and creating a situation in which value of the workers is increased[15]. The other approach is Tier I which is designed for efficiently and effectively managing the existing workforce, regardless of its skill levels. The implementation of this approach is on organization by proper management of workers in the field and communication. Both approaches will result in development of human capital which is a part of an overall human resource management. Supervisor's, superintendents and foremen should have strong management abilities for effective coordination of the activities. Higher-level hierarchy should focus on planning, scheduling and procurement for maximization for the success of the project. The Tier I approach is used for improving workforce retention, short-interval planning, and for improving the overall productivity and increasing the success rate for both project and organization.

2. Background and Literature Review

Management of materials is the process of coordinating and integrating of materials related functions such as takeoff, purchasing, evaluation of vendors, shipping,expediting of materials, materials receiving, stocking and distribution. These material related functions can be achieved efficiently byplanning of the early, training and communications[4]. The recent trend in materials management is developing computer-based approach which provides information needed for preventing materials shortages, excess of materials, labor delays, and cash flowproblems. The cost for developing and executing thecomputer based approaches has been justified qualitativelyby the results provided by them and the lack of control in their absence and also the methodologies they adopt for material management systems also has a significant on the project it includes Analysis of site and management, Inventory controlling, purchasing

procedures, Procurement and Tracking Analysis on costs. Nearly material cost 35% to 40% of the project and if proper care should be taken for the management of materials by use certain management systems.
The equipment management system will have influenceon the profit of the organization, and also for contractors with large amount of assets in equipment. FLEET is an Equipment management system which consists of four units: (1) Inventory unit; (2)maintenance management unit; (3) production unit and (4) report generating unit[5]. Inventory unit consists of the data for the equipment which includesnumber of the equipment, manufacturer, description, equipment price, market value, purchase date, and life of the equipment. Maintenance management unit will have a series of files for recording and scheduling preventive maintenance for various components of equipment,overhauls, and field/shop repairs. production unit module consists of time, cost, and production data for the equipment which includes number of the equipment, date, hourly rate, job name, insurance, interest, taxes, depreciationcostofthe equipment,fuel, oil, and greaseconsumption, storage cost, repair service, operating labor&hours, overhead, downtime, and production[5]. These data are lumped together and mapped in a file called master file. The data recorded in the other three units is accessed through the report generating unit which will produce suitable reports necessary for the purpose of effective management and to keep daily activitiesup-to-date. Development and use of these systems will increase the productivity and profit for the contractors and also for the organization.

The Tier I approach is used for improving the productivity of the construction labor by effective management and proper supervision . The Tier I strategy is used for discussing the stratigies and the methods needed to implement this approach. By this approach productivity can be increased, reduced turnover, and absenteeism of the workforce can be reduced. Tier II approach is a future oriented which is designed for improving workers' skills and productivity, which increases value of the workers. The goal of this increased value is to increase the wages and retention of the labor in the industry. It will utilize labor with some management skills and key responsibilities, work high performance, and there will be a increase in utilization of information technology. The other approach, Tier I, is designed for efficiently managing the existing manpower regardless of its skill level. These approaches depends on organization, communication, and proper utilization of manpower in the field. Both approaches will result in development of human capital which is a part of an overall human resource management. The basic characteristics of Tier I and Tier II includes highly skilled workforce, training for the workers, management of planning, training available to workers.

3. Methodology

3.1. Data collection

This research is based on a survey designed by gathering all necessary information in an effective manner. The survey presents the percentage of time or cost that can be saved by using computer based approaches for the management of three M'S in different types of construction projects based on the purpose. Based on the purpose the construction sites are divided into residential, commercial, industrial projects. The survey have been done on fifteen sites and the data has been collected for finding the percentage of reduction in the cost and time duration in any project due to lack of management systems for the management for the material, machinery, manpower. The reasons for the delays in project are also determined from the surveys and are tabulated for this purpose six case studies have been done in the sites.

3.2. Data characteristics

The data was collected primarily from the engineers who has experience of not less than five years in the construction and also from the contractors who are experience of residential, commercial, industrial buildings.

4. Statistical Analysis

After completing the data collection process, the data set was inspected for drawingresults &conclusions regarding the impact of the material management systems for the management of materials, machinery, and manpower and how much they have impact on the project or how it affects the project in terms of time and cost.

5. Limitations

In this paper the circumstances due to unexpected situations are not considered like floods, earthquakes, strikes from the labor and also the effect of material management systems on the heavy buildings and different sizes of project are not considered during research. All these will be considered in further research and approach will be made in order to minimize these effects on the project.

6. Case study

6.1. Case Study one

This case study is done on residential building which consists of G+2 stories, in this case study -1 they were not using any management systems due to which there was a delay in project of total one hundred and eight days out of which lack of proper management of materials has resulted in delay of seventeen days and due to improper management of labor has resulted in delay of eighty days and delay due to improper management of machinery resulted in a delay of five days. Remaining delays of six days are due to unavoidable circumstances i.e., strikes, floods rains, etc.

Table 1. The estimated duration and actual duration of case study one.

CASE STUDY	ESTIMATED DURATION	ACTUAL DURATION
1	295	403

6.2. Case Study two

This case study is done on residential building which consists of G+2 stories, in this case study -1 they were not using any management systems due to which there was a delay in project of total forty five days out of which lack of proper management of materials has resulted in delay of eight days and due to improper management of labor has resulted in delay of thirty one days and delay due to improper management of machinery resulted in a delay of four days. Remaining delays of two days are due to unavoidable circumstances i.e., strikes, floods rains, etc.

Table 2. The estimated duration and actual duration of case study two.

CASE STUDY	ESTIMATED DURATION	ACTUAL DURATION
2	497	542

Figure 1a.casestudies done for residential buildings one

Figure 1b. casestudies done for residential buildings two

6.3. Case study three

This case studies are of commercial projects. Case study three is a hospital which consists of basement and G+2, in this project they were not using any material management systems due to which there was a delay of one hundred and fifty three days out of which lack of proper management of materials has resulted in delay of forty seven days and due to improper management of labor has resulted in delay of seventy days and delay due to improper management of machinery resulted in a delay of thirty two days. Remaining delays of four days are due to unavoidable circumstances i.e., strikes, floods rains, etc.

Table 3. The estimated duration and actual duration of case study three.

CASE STUDY	ESTIMATED DURATION	ACTUAL DURATION
3	942	1095

Figure 2a. Layout for Commercial buildings one

Figure 2b. Layout for Commercial buildings two

6.4. Case study four

This case studies are of commercial projects. Case study four is a hospital which consists of basement and G+2, in this project they were not using any material management systems due to which there was a delay of forty two days out of which lack of proper management of materials has resulted in delay of twelve days and due to improper management of labor has resulted in delay of twenty one days and delay due to improper management of machinery resulted in a delay of eight days. Remaining delay of one day are due to unavoidable circumstances i.e., strikes, floods rains, etc.

Table 4. The estimated duration and actual duration of case study four.

CASE STUDY	ESTIMATED DURATION	ACTUAL DURATION
4	447	489

6.5. Case study five

This case studies were done on industrial buildings in which both are not using any management systems due to which there was a delay of one hundred and sixty six days out of which lack of proper management of materials has resulted in delay of fifty four days and due to improper management of labor has resulted in delay of sixty three days and delay due to improper management of machinery resulted in a delay of forty seven days. Remaining delays of two days are due to unavoidable circumstances i.e., strikes, floods rains, etc.

Table 5. The estimated duration and actual duration of case study five.

CASE STUDY	ESTIMATED DURATION	ACTUAL DURATION
5	621	787

6.6. Case study six

This case studies were done on industrial buildings in which both are not using any management systems due to which there was a delay of one hundred and eighty nine days out of which lack of proper management of materials has resulted in delay of sixty one days and due to improper management of labor has resulted in delay of eighty two days and delay due to improper management of machinery resulted in a delay of forty two days. Remaining delays of four days are due to unavoidable circumstances i.e., strikes, floods rains, etc.

Table 6. The estimated duration and actual duration of case study six

CASE STUDY	ESTIMATED DURATION	ACTUAL DURATION
6	674	863

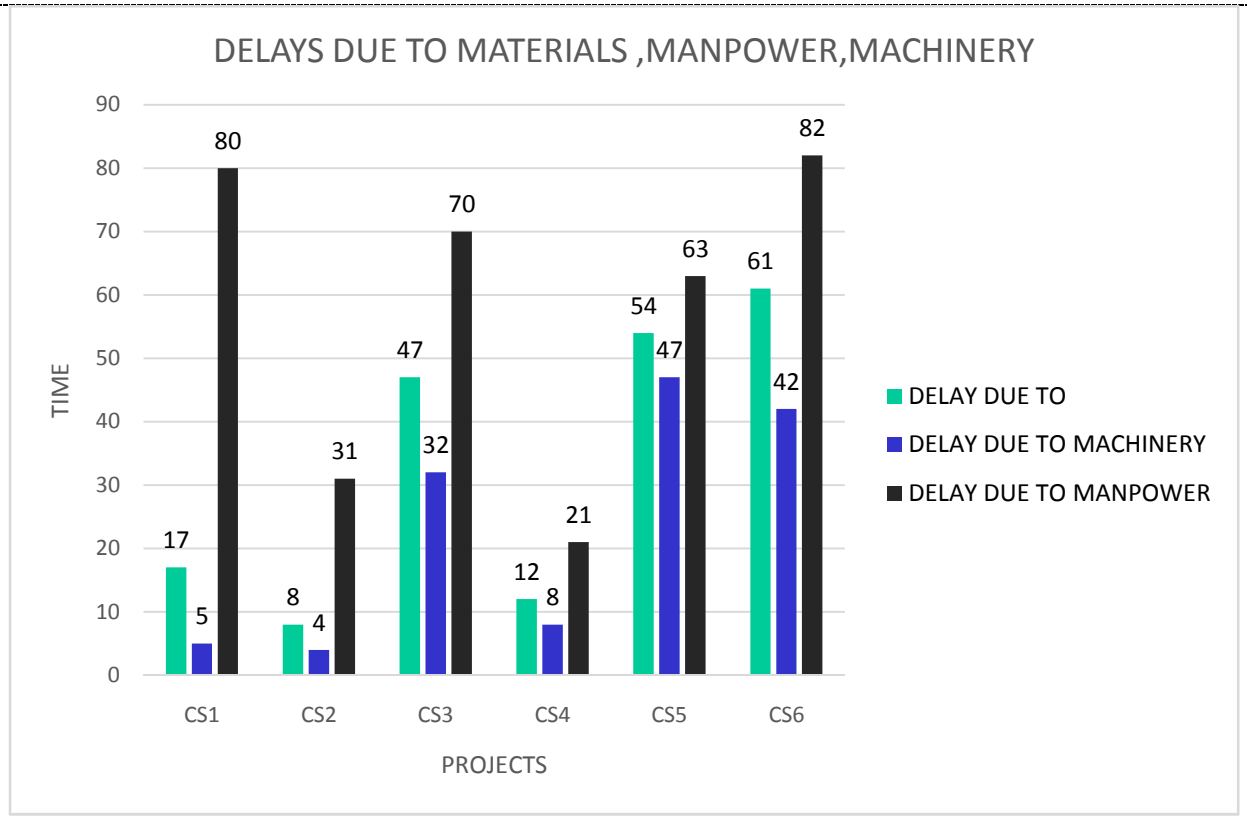

Figure 3. The Bargraph between time and delays due to materials, machinery and manpower from the case studies.

From the case studies the graph has been plotted and it can be seen that the percentage of delays various from project to project and the percentage of delay due to machinery increases from residential to industrial projects.

7. Results and conclusions

From the case studies and also from the surveys taken from the engineers and contractors it has been concluded that many of the engineers and contractors are not using any management systems for the management of materials, manpower, machinery and also it has been concluded that the percentage of delays due to lack of management systems varies according to the type of the project.

So by using the management systems the delays in any project can be reduced in turn the cost gets reduced and also for the purpose the computer based management system has been designed and given to the engineers and contractors.

In Residential buildings the delays due to lack of management systems is ninety two percentage of total delays. Table 7 gives the percentage of delays that occur due to delay in Material, Machinery, and Manpower in residential buildings.

Table 7. Gives the percentage of delays that occur due to delay in Material, Machinery, and Manpower in residential buildings.

S. No.	Description	Percentage
1.	Delay due to materials	17
2.	Delay due to manpower	70
3.	Delay due to machinery	6

Commercial buildings the delay in the project due to lack of management systems is ninety six percentage of total delays. Table 7.2 gives the percentage of delays that occur due to delay in Material, Machinery, and Manpower in Commercial buildings.

Table 8. Gives the percentage of delays that occur due to delay in Material, Machinery, and Manpower in Commercial buildings.

S. No.	Description	Percentage
1.	Delay due to materials	30
2.	Delay due to manpower	47
3.	Delay due to machinery	19

Industrial buildings the delay in the project due to lack of management systems is ninety five percentage of total delays. Table 7.3 gives the percentage of delays that occur due to delay in Material, Machinery, and Manpower in Industrial buildings.

Table 9. Gives the percentage of delays that occur due to delay in Material, Machinery, and Manpower in Industrial buildings.

S. No.	Description	Percentage
1.	Delay due to materials	34
2.	Delay due to manpower	37
3.	Delay due to machinery	27

It can be concluded from the above results that delays in any project are mainly due to manpower and materials but the percentages of delays changes from project to project. In case of equipment the percentage of delays increases from residential to industrial buildings. The management systems are developed for the management of Materials, Manpower and Machinery which are presented in Figures 3 to 5.

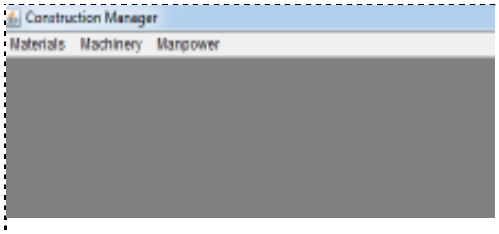

Figure 3a. The modules which were developed for the management of Materials, Manpower, and Machinery.

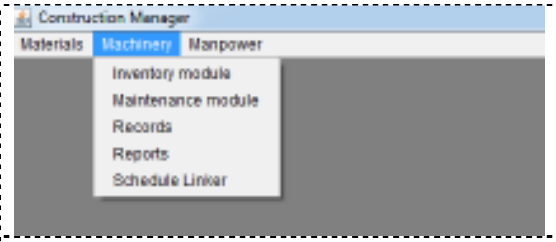

Figure 3b. The modules which were developed for the management of Materials, Manpower, and Machinery.

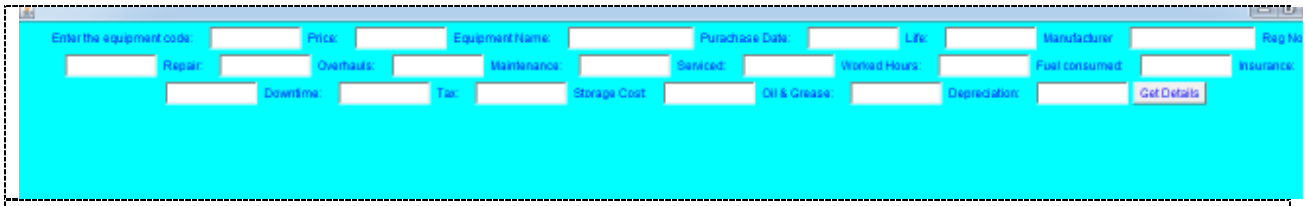

Figure 4. The modules which were developed for the management of Materials, Manpower, and Machinery.

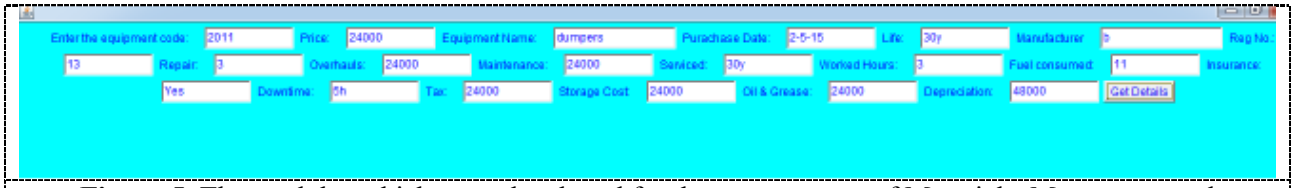

Figure 5. The modules which were developed for the management of Materials, Manpower, and Machinery.

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