Development of Mobile Application for Material Tracking and Material Management on Construction Site

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***Abstract* - Construction site is huge, dynamic and complex, involving large number of materials and resources required for the completion of site activities. Having the ability to precisely locate, track and manage the site is important for the proper and timely execution of the site activities .Studies have suggested the use of radio frequency identification (RFID) with global positioning system (GPS) in locating the materials on the site at precise time point. The use of the mobile application would lead to an minimizing the use of register for storekeeping as the whole material procurement and delivers on the site would be directly submitted through the application to the management which can analyze , the application would help in increasing the transparency and visibility of the site operations.**

Keywords – Mobile Application, Material Tracking, Construction.

I. INTRODUCTION

Construction industry is one of the major source of job creation in our country. Constructing process requires a huge number of materials and resources , almost the 50-60% of the project cost are incurred in the resources .With the increase in project size and complexity an efficient material management has become must for the successfully completion of the project. Material Management leverages the efficient utilization of materials and equipment with all necessary efforts to ensure that the right quality and quantity of materials and equipment are appropriately controlled in a timely manner with reasonable cost and availability [2]

Tracking and monitoring of information flow on a construction job site is important. Inefficiencies related to the manual operations of reporting, recording, and transferring field data in current tracking systems are becoming an ever more important issue as the size and scale of construction projects increase[2] automated materials tracking and locating on construction sites can significantly impact construction productivity. The ability to automatically detect the locations and multi-handling of thousands of items can improve the performance of material distribution, and ultimately improve project performance. Deploying a cost-effective, scalable, and easy to implement materials location sensing system in real world construction sites has recently become technically and economically feasible.

Automated materials locating and tracking technologies, such as Radio frequency identification (RFID), global positioning system (GPS), and ultra-wideband, have been developed and tested to improve construction materials management. However, implementation has been limited to field-trial levels and there is still a need to address the development and implementation of integrated technologies throughout construction supply networks [9].

II. METHODOLOGY

The study is about assessing the factors that affect successful completion of the construction project. The purpose of the study is to understand the current methods and procedure's adopted by the organization for material tracking and material management on construction projects. Analyzing the loopholes in manual method of material management on site and developing a application that could simplify the management process and could be easily understood and used by the site staff for material management. And would lead to atomize construction management and on time update to top management.

Construction materials occupy a significant part of the project contributing nearly 50% of the total project cost. Thus managing the materials is very important for the successful completion of the project. The main issue comes with the way of managing and tracking of the materials on the construction site. Therefore the method applied should be well defined. Applying methods such as RFID with GPS and GIS could be useful to maintain a track record of the materials on site.

III. DATA COLLECTION AND ANALYSIS

Information for the study has been collected using questionnaire survey both online and offline. This included semi-structured questionnaires interview guide and asked people. The questionnaire instrument was sent to the respondent and the completed questionnaires were

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collected. This instrument of data collection was used where the respondents preferred face to face interviews. This method of data collection helped to get directly involved in discussion with the respondents. Through this interaction we were able to get firsthand information. In this method, we reviewed the published literatures from different texts related to the topic under study. These mainly included journals related to Material Management.

On the basis of literature survey, interactions with expert related to Material Management project I had listed 38 factors which can contribute to material management and material tracking on construction project. After finalized all these factors online and offline questionnaire survey prepared. And through both online and offline questionnaire survey respondents rates these factors according to their importance on likert scale. The Statistical Package for the Social Sciences (SPSS) is a software package used in statistical analysis of data.

Likert Scale technique is used for questionnaire to analyze the dependent variable of research project. It uses intervals variable by distributing them into a logical order with equal distances between levels. Typically each scale item has five categories of one extreme of favorableness to other. It assumes that the strength or intensity of experience linear.

The format of a typical five-level Likert item use for survey analysis is as follows:

1. Not significant
2. Least significant
3. Significant
4. Very significant
5. Extremely significant

Mean Score ranking in this the ranking from the respondents as per their importance to the factors were taken. For this project the ranking were taken on the scale of 1 to 5 for statistical calculations. The men rating of each factor is calculated by using the formula:

$MS = \Sigma (f \times s) / N$ where $1 \leq MS \leq 5$

Where s = score given to each factor by respondents

f = Frequency of rating for each option

N = Total number of responses for particular factor

For multiple choice questions, the data were analyzed using bar charts. The percentage representation of each response was calculated using this formula:

Percentage (%) = $n/N \times 100$

Where n = number of responses obtained

N = Total number of responses for that question

TABLE I. Descriptive Statistics Factor

Sr.No	Factors	N	Minimum	Mean	Rank
1	Design Error	76	1	3.4079	24
2	Misunderstanding of owner requirement by design engineer	76	1	3.7632	8
3	Unclear & inadequate detail in drawing	76	1	3.5789	15
4	Poor site layout	76	1	3.3553	28
5	Changes in design	76	1	3.5526	16
6	Complicated design	76	1	3.7632	9
7	Poor site planning and management	76	1	3.6711	11
8	Lack of Co-ordination among parties	76	2	4.0526	1
9	Late information flow among parties	76	1	3.8684	4
10	Resource problem	76	2	3.8553	6
11	Lack of waste management plan	76	1	3.2632	31
12	Non availability of equipment	76	1	2.9737	38
13	Inappropriate construction method	76	1	3.2895	29
14	Poor supervision	76	1	3.6184	12
15	More waiting period	76	1	3.7895	7
16	Ordering error	76	1	3.3816	27
17	Shipping error	76	1	3.1447	36
18	Wrong estimation of quantity/ material	76	1	3.5526	17
19	Ignorance of specification	76	2	3.6184	13
20	Waiting for replacement	76	1	3.1842	35
21	Delay in delivery	76	2	3.9211	3
22	Damage during transportation	76	1	3.5395	18
23	Poor site condition	76	1	3.4342	22
24	Lack of space	76	1	3.2632	32
25	Left over materials on site	76	1	3.2763	30
26	Wrong material storage	76	1	3.2632	33
27	Poor material handling	76	2	3.5263	20
28	Equipment failure	76	1	3.2237	34
29	Tools not suitable	76	1	3.0395	37
30	Poor quality of materials	76	1	3.8684	5
31	Shortage of worker	76	1	3.6184	14
32	Lack of experience	76	2	3.4079	25
33	Insufficient training of worker	76	2	3.4079	26
34	Inappropriate use of material	76	1	3.4342	23

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35	Weather condition	76	1	3.5395	19
36	Theft and vandalism	76	1	3.6842	10
37	Accident on site	76	1	4.0395	2
38	Damage cause by third parties	76	1	3.4868	21

- Selection of Most Critical Factor

After calculating mean and ranking of factors I have selected some factors which are having highest mean value and so are the most critical factor. Lack of Co-ordination among parties, Accident on site, Delay in delivery, Late information flow among parties, Poor quality of materials, Resource problem, More waiting period these are the seven factor that affect the construction site. Also from direct site visit and actual consultation with site engineers the main factors are Slow processing time, Lost paperwork and difficult referencing against the original purchase order, Higher Chance of Human Error, Time consuming in transfer of data and Maintaining records, Resource Problems on site, Misinterpretation of the information, Non Effective and timely communication with suppliers about delivery issues affects the project.

IV. Mobile Application Frame Work

A. CiviApp Login SignUp

SignUp → Company Display Name
→ Instance Name (Site Name)
→ Admin User → Full Name, User Name, Password

Login → Username, Password

B. CiviApp ☰ Home Site Name User

☰ → Add Supplier
→ Add Purchase Order
→ Add Item
→ Add Activity
→ Add Work Area
→ Add User

HOME → Goods Received Note
→ Daily Progress Report
→ Daily Expense Slip
→ Stock In Hand
→ Issues and Requirements

a) ADD

- Add Supplier

Description → Company Name, Company Address, Contact No, Email Address, GST No, PAN No, Bank Account No

- Add Purchase Order

Description → Site Name, PO No, Supplier, Date, Remark
Item → Name, Unit, Quantity, Price, % Discount

- Add Item

Description → Material Name, Unit

- Add Activity

Description → Activity Name(Concreting ,Plastering), Unit, Dimensions (l*b*d, l*b)

- Add Work Area

Description → Name as per site

- Add User

Description → Full Name, Username, Password (Changeable), Designation

b) HOME

- Goods Received Note

GRN Create

(Previous History)

GRN No Created At PO No Supplier Export File

➢ Create New

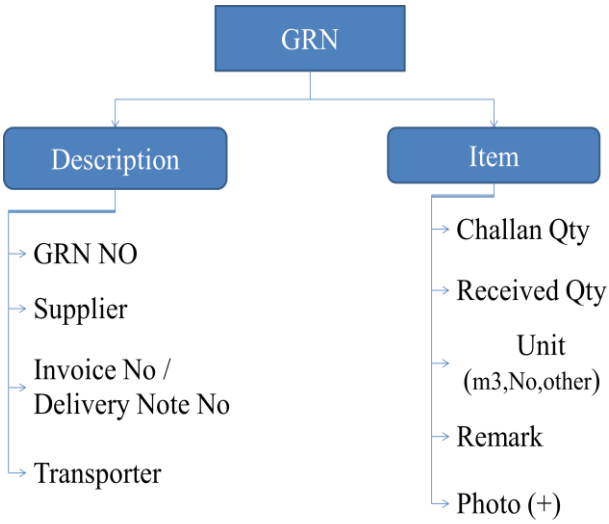

Fig.1.Frame Work of GRN

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- Daily Progress Report

DPR Create

(Previous History)

DPR No Created At GPS Location Export File

➢ Create New

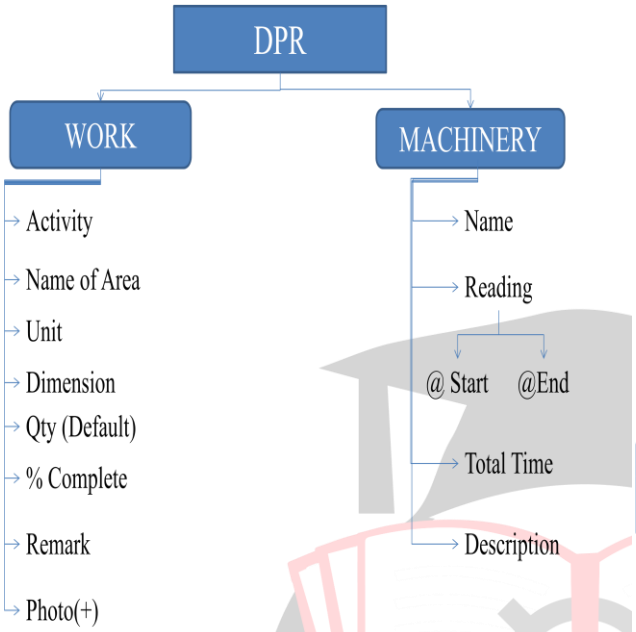

Fig.2. Frame Work of DPR

- Daily Expense Slip

DES Create New

(Previous History)

Expense Detail Created At Mode Amount Export File

➢ Create New

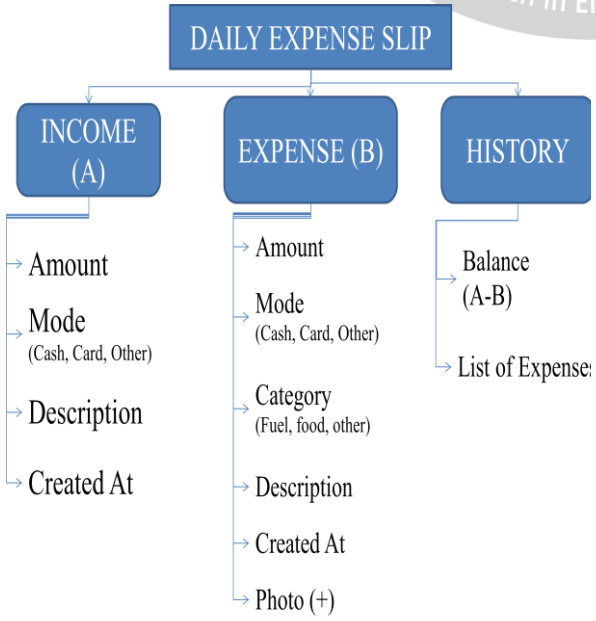

Fig.3. Frame Work of Daily Expense Slip

- Stock In Hand

SIH Create New

(Previous History)

Material Name Created At Qty Unit Export File

➢ Create New

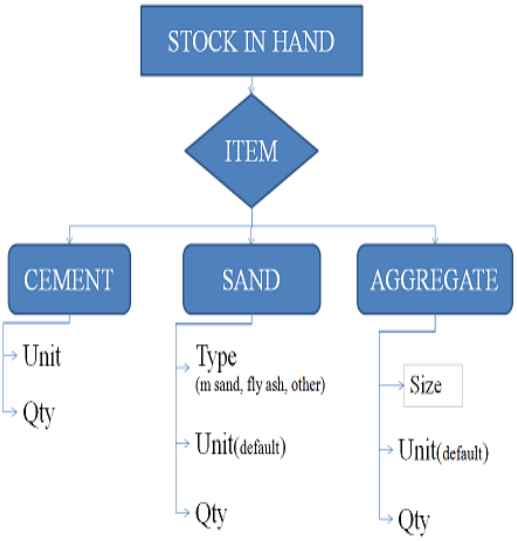

Fig.4. Frame Work of Stock In Hand

- Issues and Requirement

IAR Create New

(Previous History)

IAR No Created At Export File

➢ Create New

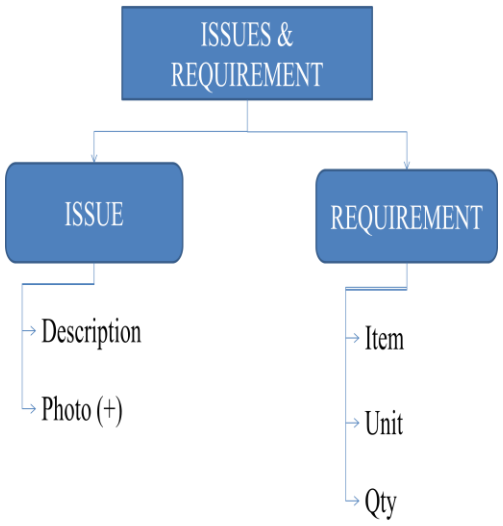

Fig.5. Frame Work of Issues and Requirement

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V. CONCLUSION

The study of material management and tracking concluded that for an efficient and timely completion of the project, a precise control over the material flow on the site is important as materials consist of 50-60% of the project cost. In most of construction companies resource management is carried manually, to achieve higher productivity there is requirement of change in resource management. Also due to increase in complexity of the project the manual method of material management are proving to be inefficient.

For project the current procedures of material management on different sites were assessed individually with methods adopted for managing and tracking the material flow on site. The various technologies for material management and tracking already exist and are widely used in various large size companies/organization because of their many advantages. But lacks to attract small or medium size organization because of their complex methods of application and heavy investment requirements.

So the development of the mobile base application is important to efficiently manage and track the ongoing site activities. By using application, the record maintaining of stock material with their location can be achieved. It would help in bringing more supply network visibility within the organization. The research proposed the development of reliable and cost-efficient method of storing the site data with more visibility within the organization. This mobile application can successfully address the requirement of configuring the data from different small to large site with variety of materials.

The application would help in managing the construction site and would be helpful in time saving on material procurement and delivery directly leading to cost savings and maximization of project profit.

FUTURE SCOPE OF WORK

For the future researches the proposed application can also be updated with new features and tracking system that would help in more effective and precise control over the construction project. The proposed future update could be Bio-Metric attendance of workers and contractors with their precise Inn and out time, with provision for extra time entry. This would help in further atomization of site work and could help in reducing processing time with increase in network visibility within the organization.

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