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Comparative Study of Traditional Material Management and Material Management with ICT Application

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Abstract – For management of a productive and cost efficient site, efficient material management is very essential. Research has shown that construction materials may constitute more than 50% of the total cost for a typical construction project. Therefore the proper management of this single largest component can improve the productivity and cost efficiency of a project and help to ensure its timely completion. One of the major problems in delaying construction projects is poor material management. The material management system attempts to insure that the right quality and quantity of materials are appropriately selected, purchased, delivered and handled on site in a timely manner and at a reasonable cost. This paper contains the different methods used by the construction companies and also describes the main results of survey carried out in Pune in different construction companies for their current material management process.

Keywords – Material management, Construction materials, ICT

1. INTRODUCTION

For every construction industry material is required. In construction projects materials constitute major cost. Generally the cost of materials contains 50% to 60% of total cost of the project. In construction projects, material management is carried out to minimize wastage of material, shortage of material, damage of material, lack of storage space, and delay in supply.

1.1. Material management

Material management is a scientific technique, concerned with planning, organizing and control of flow of materials, from their initial purchase to destination. Material management contains mainly 4 processes i.e. planning, procurement, logistic and inventory.

1.2. Material management problem

The current manual material management process is unsatisfactory because they are labor intensive, inaccurate and error prone. In Pune, during survey following were the main manual material management problems found in construction companies.

1) Manual error
2) More paper work
3) Details cannot be found easily
4) Punctuality is less
5) Difficult to take on site decision
6) Easy updating is not possible
7) Exact location of material cannot be found
8) Lengthy procedure
9) Communication problem
10) Papers are missing

1.3. Objectives of material management

- Efficient material planning
- Buying or purchasing
- Procuring and receiving
- Storing and inventory control
- Supply and distribution of material
- Quality assurance
- Good supplier and customer relationship
- Improved departmental efficiency

To fulfill all these objectives there should be good co-ordination between all the employs of material management department and also this department should have good co-ordination with other departments in the organization.

1.4. Functions of material management

To fulfill the above stated objectives the functions of the material management are also categorized.

(i) Primary Functions

- Materials Requirements Planning (MRP)
- Purchasing
- Inventory Planning and Control
- Ascertaining and Maintaining the Flow and Supply of Materials
- Quality Control of Materials
- Departmental Efficiency

(ii) Secondary Functions

- Standardization and Simplification
- Make and Buy Decisions
- Coding and Classification of Materials
- Forecasting and Planning

2. PREVIOUS RESEARCH WORK

Fara Diva Mustapa, Muzani Mustapa, Mohd Saidin Misnan, Syamsul Hendra Mahmud (2012) had worked in that area. According to them material shortage, delay in supply, price fluctuation, damage & wastage, lack of storage space of materials problems are which can be overcome with the use of ICT in material management. They have surveyed 10 construction firms those are

working for more than 10 years in Sarwak. They found that, at the planning and procurement stage more ICT tools are used than the logistic and inventory. They found that modern technology like RFID and bar code has not been utilized and considered as nonexistent in construction firms for material management because of its high cost.

Khyomesh V. Patel, Prof. Chetna M. Vyas (2011) had discussed about benchmarking process for waste control in building material. They have discussed the objectives and functions of material management. They discussed the process of material management i.e. planning, purchasing receiving, inspection, stacking and storage, issuing material. They have taken survey of material management in Ahmadabad of 3 known builders. They found that there should be centralized material management team co-ordination between the site and the organization. In construction industry there should be proper control, tracking and monitoring of the system is required and also awareness & accountability should be created within the organization.

N. B. Kasim, Peniel Ang Soon Ern (2010) had discussed process of material management. They have taken interview and questionnaire survey of A class contractors in Malaysia. The questionnaire survey was taken on implementation of ICT and interview was taken on acceptance of ICT for material management. They found that, main barrier of implementation of ICT is high cost and there was just average level of acceptance of ICT by the industries. In construction industries, for material management Microsoft office and handheld devices are widely adopted but bar code and RFID tools are not adopted.

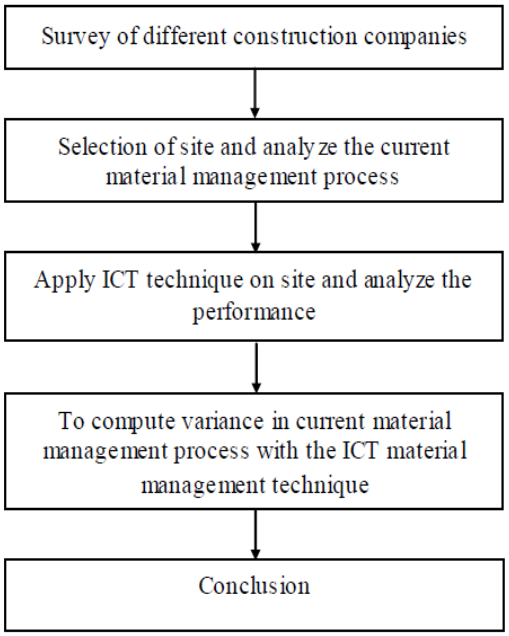
Narimah Kasim (2011) worked in that area. He has discussed the process of material management. He found out the problems in material management such as lack of site storage spaces, small unloading area. ICT can reduce the level of confusion regarding the materials delivery from suppliers. He has taken a survey of 'A' class contractor in Malaysia regarding implementation of ICT and discussed their results. The main reasons of resistance towards the increased level of implementing ICT in materials management are due to the high cost of investment.

Narimah Kasim, Rozlin Zainal, Alina Shamsuddin, Naadira Che Kamarudin (2012) The poor material management can affect the overall construction time, quality and budget. Generally the material management information is shared by papers which are error prone. They have discussed the materials management on construction projects and potential to employ RFID in materials management practices. For large projects material management, complexity always increases. According to them the ICT can give good facility for these large projects.

2.1. Objectives of the study

- To survey construction industries to study and analyze the present practices of material management.
- To see how many construction industries use Information Communication Technique (ICT) tool for material management.
- Apply and analyze the effect of Information Communication Technique (ICT) on material management.
- To compute variance in traditional and Information Communication Technique (ICT) applied material management process.

2.2. Methodology



3. CASE STUDY

In Pune, seven construction companies were surveyed regarding their current material management process. This survey was questionnaire based survey. The survey was taken regarding acceptance of ICT, its benefits and main barriers of implementation of ICT.

TABLE (1) ANALYSIS OF SURVEYD CONSTRUCTION COMPANIES FOR MATERIAL MANAGEMENT

Name of Company	Company 1	Company 2	Company 3	Company 4	Company 5	Company 6	Company 7
Type of project	Residential	Residential, SEZ, School, Malls	Residential, Commercial	Residential, Commercial	Residential, commercial, PMC project	Residential	Residential, Commercial, Educational, Infrastructure
Cost of project (Cores)	112	5000	2.5	15	125	25	3000
Is MM carried out?	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Total cost of materials (%)	60	60	60	70	60	50	60
Method adopted for MM process	Manually	Software	Manually	Manually	Manually	Manually	Software
Type of software used	-	ERP (High-Rise)	-	-	-	-	SAP
Satisfaction of Current MM process?	Yes	Yes	No	No	No	Yes	Yes
Benefit of current MM	Less cost, Easy to understand	Get details easily, Updating easily possible, Gives correct stock	Less cost, Less man power, Non technical person can handle	Maintain stock, Less cost, Easy to understand	Less manpower, Cost is less	Less cost, Non technical Person can operate	Reduce wastage, Easily contact with others
Problem facing in current MM	Manual error, More paper work, Easily details cannot find out, Easily cant update	No	Manual error, Exact location can't find	Manual error, More paper work	No accurately operation	Manual error	Skilled person requires but satisfied
JIT concept used?	No	Y (for some material)	No	No	Y (for some material)	No	No
Bar code technique used?	No	No	No	No	No	No	No
Benefit of ICT	Accurate work, Wastage of material reduces, Exact data of consumption and stocked material	Good communication, Easily find location and consumption of martial, Reduces paper work	Maintain stock well, Reduces manual error	Time management, Reduces paper work, Easily communication	Easily location, Get information of branded material is not, Reduces manual error, Computerizing reduces work	Automatic recoding, Maintained record very well	Easily communication
Barriers of implementing ICT	High cost, Board of directors	Not advisable to construction industry, High cost	More man power, Technical person requires	High cost	More manpower	High cost	Not possible in construction industry

4. RESULTS

After completion of questionnaire survey, following outcomes commemorated regarding material management system from the various construction companies.

4.1. Benefits of manual material management process

- For small site it is beneficial.
- In Construction Company if only one project is going on then it is beneficial
- Unskilled workers or non technical person can carry out
- Less cost
- It is easy to understand
- It requires less man power

4.2. Disadvantages of manual material management process are

- Paper work increases
- Manually error occurs
- Difficult to find details
- Not easy to find updates
- Missing of papers occurs

4.3. Benefits of ICT technique in construction

- Can easily find out exact consumption of materials
- Can easily get stock of materials and locations of materials
- Accuracy increases
- By only one click, one can easily get all details
- It can be useful in planning and procurement of materials
- Wastage of materials get reduced
- Work becomes easy
- Manual errors get reduced
- Time can be reduced for management of materials

- It is easy to communicate or share the information regarding materials

4.4. Barriers of implementing ICT technique in construction

- High initial cost
- It requires more man power to apply a tag
- Each material cannot be bar coded eg. coarse aggregate, fine aggregate, ready mix concrete etc by using bar code
- Need to train workers

Open ended questions and detail discussion with the project managers were carried out and answers were received and it was concluded that maximum ICT tools were being used in planning and procurement stage while minimum ICT tools were being used in logistic and inventory stage.

4.5. Different ICT tools used in planning stage are showed in fig no. 1.

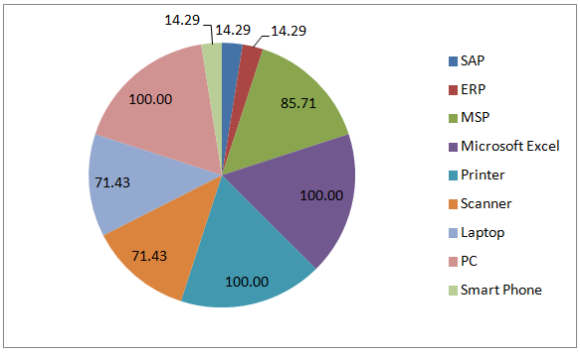


Fig. 1. ICT techniques used in planning stage

1. 100 % companies were using Microsoft excel, printer and PC type ICT tools in planning stage.
2. 14.29 % companies were using SAP, ERP software and smart phone ICT tool in planning stage.

4.6. Different ICT tools used in procurement stage are showed in fig no. 2.

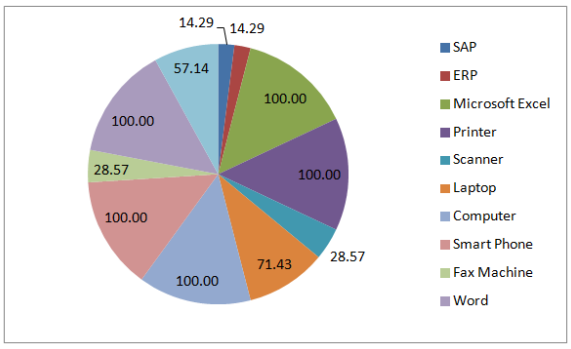


Fig. 2. ICT techniques used in procurement stage

1. 100 % companies were using Microsoft excel, printer, computer, smart phone and word type ICT tools in procurement stage.
2. 14.29 % companies SAP and ERP software were using in procurement stage.

4.7. Different ICT tools used in logistic stage are showed in fig no. 3.

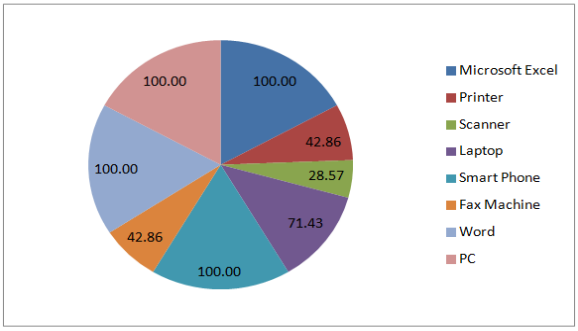


Fig. 3. ICT techniques used in logistic stage

1. 100 % companies were using Microsoft excel, smart phone, word and PC type ICT tools in logistic stage.
2. 28.57 % companies were using scanner ICT tool in logistic stage.

4.8. Different ICT tools used in inventory stage are showed in graph no. 4.

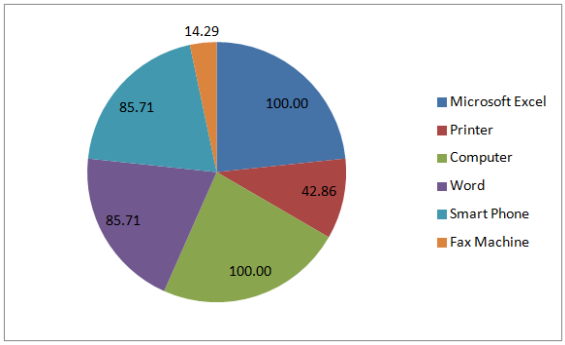


Fig. 4. ICT techniques used in invrntory stage

1. 100 % companies were using computer ICT tool in inventory stage.
2. 14.29 % companies were using fax machine ICT tool in inventory stage.

5. DISCUSSION

Every construction company carries material management process. Each company does not use advanced technique but at least they carry out material management manually. Among the surveyed companies only Company No. 2 and Company No. 7 are using software for material management and remaining all are carrying material management manually**.** Company No. 2 is using ERP (High-Rise) software where as Company No. 7 is using SAP. To adopt such software for material management the companies turn over must be more than 100 cores. Then only it becomes economical. Figure 1 shows the method adopted for material management process. 28.57% companies are using software for material management and 71.43% companies carrying material management manually.

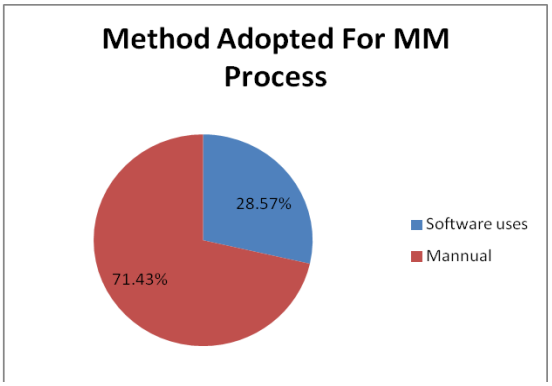


Fig. 5. Method adopted for MM process

For their current material management process Company No. 1, Company No. 2, Company No. 6 and company No. 7 these construction companies were satisfied for their current material management process. The project managers of Company No. 3, Company No. 4 and Company No. 5 these construction companies were not satisfied for their current material management process. Figure 2 shows the satisfaction of current material management process. 57.14% companies are satisfied for their current material management process and 42.86% companies are not satisfied for their current material management process.

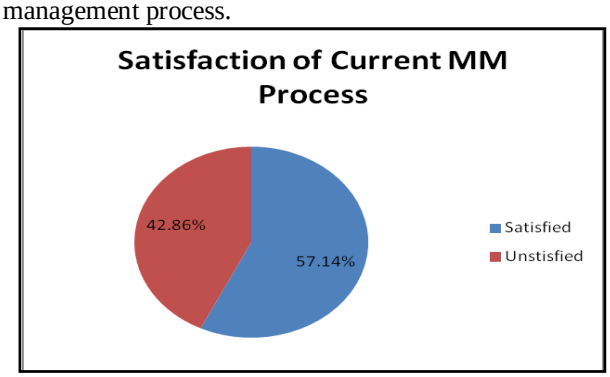


Fig. 6. Satisfaction of current MM process

According to project manager of Company No. 3, there should be advanced technique used rather than manual for material management. Not even a single construction company is using RFID or bar code technique for material management. Some companies are trying to use zero-inventory or just in time concept but for every material it's not possible because high risk of work stoppage is involved. The ICT technique is having lot of advantages but it is having barriers also. Its high initial cost is the main barrier. Generally construction companies contain more than one board of directors. So, if one agrees to implement other will not, that is also main barrier found out during survey.

6. Implementation of ICT Technique Actual on Site

The ICT technique i.e. bar code was implemented on a site for 2 flats. During survey it was found that, for implementation of bar code technique in construction companies it will require more manpower but during implementation of bar code technique actually on site it was found that no extra manpower was required. But if huge amount of material is there then there may be extra labor required. Table 2 shows that the average percentage cost of materials saved by ICT technique without considering implementation cost is 6.35%. Average percentage cost of materials saved by ICT technique with considering implementation cost but without extra labor cost is 4.47%. It also shows the net present value, profitability index and pay back period of bar code system (printer, scanner, bar codes) considering life of bar code system is 7 years and interest rate 11%

Table (2) Results

	Average % cost of materials saved	NPV	PI	PBP
ICT without considering implementation cost	6.35%	Rs.396500	19.02	3 months
ICT with implementation cost but without considering extra labor cost	4.47%	Rs.270200	13.27	5 months

6.1. Problems faced during implementation of bar code

- There should be clear line of sight between scanner and bar code.
- Bar code scanner has short range.
- Bar code scanner is hard to read in heavy sun light.
- The bar codes may be damaged by heavy dust.
- It should be made sure that the codes are properly stuck to the materials. There are chances of removing codes.
- Each construction material can not be managed by bar code eg. steel, binding wire, coarse aggregate, fine aggregate

7. Conclusion

Generally material management is carried out manually in construction companies. But to achieve a profit, there is need to change process of material management. By using ICT technique, exact consumption of material, stocked material, and location of material can be obtained. It reduces manual errors and it is easy to communicate. In Pune, there is no construction company which has adopted ICT technique such as RFID or bar code technique for material management. The main barriers of implementation of ICT are its high initial cost and lack of agreement amongst all the board of directors. The construction companies are using maximum ICT techniques in planning and procurement stage while minimum in logistic and inventory stage. The profitability index is more than one and net present value of ICT tool is positive so it can be accepted.

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APPENDIX

To carry a survey regarding material management in construction companies following questionnaire were prepared.

SR. No.	Details	
1	Name of organization	
2	Name of owner	
3	Address of organization	
4	Address of site	
5	Year of establishment of organization	
6	Turnover of organization	
7	Which types of projects are going on?	
8	Cost of the project	
9	Telephone No.	
10	Email address	

Sr. No.	Questions	Yes	No
1	Do you carry out material management on your site?		
2	Are you satisfied with current material management process?		
3	Are there any benefits of current material management process?		
4	Are there just in time concept is used?		
5	Is there schedule of procurement of materials are prepared?		
6	Are you using any ICT (Information Communication Technology) tool for material management?		
7	Are you satisfied with ICT (Information communication Technology?)		
8	Are material management details have been discussed within the organization?		
9	Is there any type of software is used for material management?		

Sr. No.	Questions	Comment
1	From when you are using material management process in your industry?	○ None ○ 6 Months ○ 1 Year ○ 1.5 Years ○ 2 Years ○ 2.5 Years ○ 3 Years ○ 5 years ○ More than 5 years
2	In which activity material management process is carried out?	○ Planning ○ Purchasing ○ Receiving ○ Inspection ○ Inventory ○ Logistic
3	Which method you have adopted for material management process?	○ Manually ○ Bar Code ○ RFID ○ Handheld Devices ○ Software ○ Any other
4	Which type of software is used for material management?	○ ERP ○ Primavera ○ Microsoft project ○ Any other ○ None
5	What is the cost of the tool used for material management?	
6	What is the total cost of materials?	

7	Which are the costly materials used on site?	
8	How many storage locations are used on site?	

Category of material	Type of materials	Cost of material	Quantity of material
A			
B			
C			

1. Why you use material management in your construction industry?
2. What is the process of material management?
3. If not, why you don't carry out material management in your construction industry?
4. What are the benefits of current material management process?
5. What are the problems you are facing in current management process?
6. How order of the materials has been placed?
7. How you record and maintain the quantities of materials which are consumed and stored?
8. Why you don't adopt "just in time" concept?
9. What is the time lag between procurement of materials and using of materials?
10. For which purpose are you using ICT (Information Communication Technology) tool?
11. What are the benefits of ICT (Information Communication Technology) implementation?
12. What are the barriers towards ICT (Information Communication Technology) implementation?
13. By using bar code which type of materials can be manage?

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