IDENTIFYING AND ASSESSING WASTE MANAGEMENT INFLUENCE FACTORS AND CHECK LEVEL OF PERFORMANCE FOR BUILDING CONSTRUCTION PROJECT

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Abstract - Environmental sustainable development has major target for building construction project, and waste management is very important in construction industry. India has promoted the many policies to control waste generation but still ineffective to waste management for building construction project. The lack of quantitative evaluation methods and good guidance by project practitioner are Due to lack of knowledge and experience .the main aim purpose of this research to identifying and assessing influence factor and check the level of performance for building construction project. In this paper 59 factors were identified and all the factors are divided into five category such as man power, material and equipment, construction method management practice, industry policy. All the factors are help to waste minimize and recycling for building construction site and also help to develop waste management method for particular area of construction site. Every day life construction industry increases, this method effectively help to minimize and recycle construction waste and check the level of performance for building construction project. This tool gives the result in the form of total index

Key Words: **Construction Management, Sustainable Environment, Waste Management, Recycling and Reuse.**

1. INTRODUCTION

Resource depletion, global warming, climate change are caused due to excessive waste generation by the construction industry. These wastes are hazardous to our environment and human beings, the pollution which are generated by building construction industry such as air, dust, noise pollution and construction and demolition waste generation. Many countries try to minimize this waste by promoting many policies and awareness program in building construction site. However, most building environmental assessment is focused on the level of performance resulting from building design strategy. They still fail to cover environmental issues related to waste generation; these are not able give to proper guidance to control waste generation. The objective this research paper to identifying influence factor and development of assessment tool and check level of performance for building construction project for Gwalior (mp) area, it is a case study for particular area. In this paper six major sections are involved such as introduction section, methodology, overview, questionnaire survey, question response format sheet and score collection, calculation of total index. The country like India growth of population is high, this increase of population are also responsible for the rapid industrialization of building construction project, people migrated from village to urban area, surrounding urban area which is used for agriculture purpose right now, which is covered by building construction industry. Due to this rapid industrialization waste generation increases day by day and natural resources are depleted, this is uneconomical for our environment. We have to need pre-installment of recycling and minimizing waste management equipment. we are discuss about area like Gwalior, here area of availability is more for dumping construction, we can throw the waste easily because area of availability is more. But in future after 10-20 year all the area covered by multistory high rise building in that situation , we have no space available for throwing of the waste in that situation this research very effective in waste minimization and recycling for building construction project. By this method, we can check the level of performance for building construction project. And improve the level of performance by change the methodology, equipment, material and policies

1.1 OBJECTIVE

- Identifying waste management influence factors same through the questionnaire survey.
- Evaluation of waste management factors by total index formula through which suitability of that factor are analyzed.
- Check the level of performance different building construction sites in Gwalior areas.
- Reflecting trend or cause and effect relationships.

1.2 METHODOLOGY-

- Technical approach and management policies and face to face interview were conducted with construction site managers. Almost the high rise residential building area located near Gwalior, India were targeted for this investigation with these sources a preliminary listing of factors that might improve the waste management practice has developed.
- The factors were finalized and categorize into five areas including manpower, construction method, material and equipment, management practice and industry policy.
- It's a case study for a particular area all these identified waste management influence factors help to assess the waste management performance at construction site also helpful to reduce, reuse to individual construction sites.
- Complete set of 59 factors were identified these all the factors were divide into five categories. These factors are those whose help to recycling, minimize and reuse the waste management.
- These all 59 factors are listed in chart; these factors are distributed among all the construction site of Gwalior, India. In this paper all the sites are consider Gwalior and surrounding area.
- To investigate the magnitude of all the 59 factors, the questionnaire survey has been conducted. In this questionnaire survey identified influence factors are distributed among the entire individual construction site and respondents are requested to select the best option between 0 and 10 in terms of relative importance. A score of "10" represent the most significance on decreasing waste and increasing recycling whereas a score of "0" represent no influence on decreasing waste and increasing recycling
- The survey participants were selected among all the construction site of Gwalior area. These all site specially selected high rise building construction project. Entire 59 influence factors were distributed individual sites of Gwalior area these factors are distributed more than 60 site, 40 respondent are give the response score in between 0 and 10 , out of 40 site manager, 9 project manager are give unbelievable reading data. They excluded from them. Only 31 responses are valid for calculation point of view. The average work experience of the individual respondents turned out to the approximately more than six years.
- After collection of valid response sheet from different building construction site
- Calculation of mean and standard deviation of all the waste management factors by the help of Microsoft excel and select optimum number of waste management influence factor.
- After selection of optimum number of waste management influence factors, entire factors have converted into question response formats.
- Find out total index value by the empirical equation and relate with waste management performance for building construction project.

2. IDENTIFIED INFLUENCE FACTORS

Category	S.No.	Factor Name	Factor
MANPOWER	1	**A1**	Commitment of contractor's representative of a site
	2	**A2**	Appointments of laborers only for wastes disposal
	3	**A3**	Organization breakdown structure involved in waste management
	4	**A4**	Cooperation of subcontractor's
	5	**A5**	Education of the contractor's staff (engineer's)
	6	**A6**	Education of the subcontractor's staff (laborer's)
	7	**A7**	Preventing waste of material by laborer's
MATERIAL	8	**B1**	Minimizing rework on a construction phase
	9	**B2**	Design and construction using standardized materials
	10	**B3**	Collecting packed materials back by supplier's
	11	**B4**	Prefabrication materials
	12	**B5**	Use of recycle materials
	13	**B6**	Preventing easily fragile materials from being used
	14	**B7**	Minimizing loss of material during carrying and storing
	15	**B8**	Preventing from excess order material's
	16	**B9**	Recycling of temporary materials used once in general
METHOD	17	**C1**	Setting up separated bins by waste type
	18	**C2**	Providing bins for collecting waste for each subcontractor's
	19	**C3**	Sorting out individual waste by type from mixed waste

	20	**C4**	Setting up temporary bins at each building zone
	21	**C5**	Notice recyclable materials to laborers
	22	**C6**	Storing waste at an easily accessibly areas
	23	**C7**	Designate a place of storing waste in early stage of construction
	24	**C8**	Notice on waste type responsible staff etc. to waste bins.
	25	**C9**	installing equipment for recycling in a site.
	26	**C10**	informing methods to deal with rest waste after recycling
	27	**C11**	installing an information board to notice categories for separating waste
	28	**C12**	preventing mixing waste with soil
	29	**C13**	prohibiting use of pipes for dumping down mixed waste
MANAGEMENT	30	**D1**	rules on dealing with wastes by waste generators
	31	**D2**	contractual clauses for subcontractor's in dealing with wastes
	32	**D3**	positive incentive for decreasing or recycling by subcontractors
	33	**D4**	keeping a record about waste management (amounts, kinds, etc
	34	**D5**	contractual clauses about the latest method for a waste disposal agency to treat waste
	35	**D6**	shortening a period of collecting wastes in a site
	36	**D7**	establishing a waste management plan in early stage of construction
	37	**D8**	checklist on executive detailed waste management plan
	38	**D9**	shortening a period of taking waste out of a site
	39	**D10**	check list for document to writing out and submit
	40	**D11**	deciding an objective rate for recycling waste
	41	**D12**	confirming capability of a firm which treats the waste
	42	**D13**	keeping a record about recycling waste
	43	**D14**	informing recycling methods and uses in a site
	44	**D15**	checking a route periodically for a waste agency to carry wastes
	45	**D16**	checking the last status for a waste agency to treat wastes
POLICY	46	**E1**	obligatory cost estimating cost for waste treatment in a bill of quantity
	47	**E2**	incentive in bidding for a contractor
			having a plan about decreasing waste and increasing recycle
	48	**E3**	tax free for equipment treating waste
	49	**E4**	supervising waste management by a residential officer
	50	**E5**	enhancing punishment of illegal treatment of waste
	51	**E6**	establishing criteria for quality and safety of recycled materials
	52	**E7**	simplifying legal procedure to install equipment treating waste
	53	**E8**	constructing marketing structure for recycled material
	54	**E9**	activating development of technique to treat recycled waste
	55	**E10**	raising charge for mixed waste
	56	**E11**	changing the subject of a legal report from an owner to contractor who manages waste in practice
	57	**E12**	reducing charge for separated waste
	58	**E13**	data base management system for constructing waste
	59	**E14**	managing data for waste by a head office

Table-1 Identified waste management factors

2.1 QUESTIONNAIRE SURVEY:

To investigate all 59 factor on their relative importance based on questionnaire survey has been conducted. In this survey, the response sheet in which all the factor mentioned are distributed at various construction sites of Gwalior area and respondent are requested to select the best preference in between 0 to 10 .if response 0 is given by respondent it means that this factor has no significance for waste minimization and recycling for a particular building construction project. If response 10 is given by respondent it means that this factor has more significance to waste minimization and recycling for particular building construction project. The survey participants are selected.

2.2 ASSESSMENT OF MEAN AND STANDARD DEVIATION DIFFERENT FACTORS

RANK	FACTOR IDENTIFICATION	MEAN	STANDARD DEVIATION
1	B2	8.0645	.9638
2	A1	7.5320	1.4314
3	B1	7.4190	1.5763
4	A3	7.0906	1.2980
5	C7	6.9033	1.6952
6	E1	6.9032	1.9554
7	A5	6.8870	1.2761
8	E4	6.8484	1.1772
9	E3	6.8387	1.6349

10	B3	6.7581	2.2318
11	C8	6.6774	1.8865
12	B8	6.6451	1.7136
13	B7	6.5484	1.7528
14	D5	6.5419	1.2252
15	C12	6.5161	2.0227
16	E14	6.4354	1.7259
17	D6	6.4354	1.5955
18	D3	6.3871	1.7209
19	C1	6.3709	1.5756
20	E2	6.3065	1.3334
21	D4	6.3063	1.5093
22	B9	6.2838	1.5038
23	A7	6.2580	1.7975
24	D9	6.2420	1.6425
25	D16	6.2419	1.7023
26	A2	6.2260	2.4570
27	C2	6.2258	1.7408
28	D1	6.2256	2.4961
29	C6	6.1935	1.5741
30	E11	6.1774	1.3137

TABLE-2 Mean and Standard Deviation

3. SELECTION OF OPTIMUM NUMBER OF WASTE MANAGEMENT INFLUENCE FACTOR

Optimum number of waste management influence factor can be selected by the calculation of mean, mode, standard deviation. In this process all collected waste management factors mean , standard deviation are calculate by the use of Microsoft excel, arranged all the factor as per rank order. Listed below in table, highest mean factor are written in top most level and also written standard deviation. Manpower category factors are listing in top ten. As such it can concluded that, management practice participation is critical in sustained. Industry policy factors also under top ten listing factor in waste management practice. On the basis of static analysis top five ranked factors were effectively identified as most significant in waste management.

B2. Minimizing rework on construction phase

A1. Commitment of contractor's representative at a site

B1. Collecting packed material back by suppliers

A3.co-operation of sub-contractors

C7. Notice on waste type, responsible staff

By the static analysis result can simply imply an identified waste management factor in term of relative importance. It is noteworthy that highest scored factors have relatively low standard deviation. All the 59 factors were divided into five category and weight of each category were calculated.

3.1. WEIGHTAGE INDEX GRAPH OF ALL CATEGORY

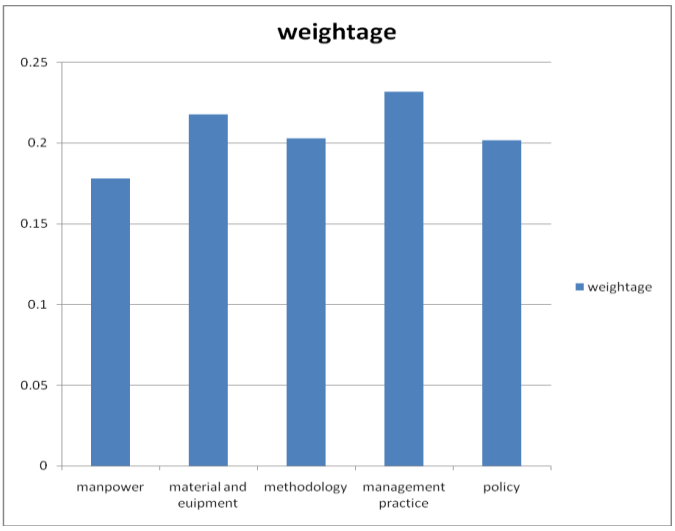
Highest weightage category is management practice. The weight value is 0.28, material equipment, construction method, manpower are listed in descending order.

4. CONVERSION OF ALL FATORS INTO QUESTION RESPONSE FORMATE

Waste management tool as much power full when we have quantification approach. The entire 59 waste management factor are difficult manage. Top half of the factors are considered for waste management tool. These 30 factors are affectively assessing the level of waste management performance. All of the 30 factors, six factors belongs to policy category, policies are varies from industry to industry that's why all these factor belongs to policy category were excluded from question response format. Left over 24 factors were converted into question response format` these 24 factors are finalized for waste management tool. User subjected to select best option for each factor. For example

Is the contractor representative committed to waste management in order to quality there are four option based degree of commitment (a) strongly agree (b) somewhat agree (c) moderate agree (d) somewhat disagree (e) strongly disagree. All the finalized 24 waste management factors are converted into question response format. It is noteworthy that some of the factors have more than one question to be answer. Responses are collected different building construction for the calculation total index. Response score collected between 0 and 1. 0 is the minimum score and 1 is the maximum score for management factor, intermediate score are (0.5, 0.75 etc.)

These factor score are used for calculation of total index



WEIGHTAGE INDEX GRAPH-1

FACTOR IDENTIFICATION	QUESTION	RESPONSE OPTION	SCORE
A1	Is the contractor's representative committed to waste management?	A. strongly agree B. somewhat agree C. moderate D. somewhat disagree E. strongly disagree	1 0.75 0.5 0.25 0
A2	Are there any laborers solely in charge of wastes disposal?	A. yes B. no, worker on contractor side partly in change C. no worker on subcontract side partly in change D. none is designed	0.84 0.62 0.47 0.26
A3	Are subcontractors cooperative for waste management? Are wastes decreased by cooperation of subcontractors?	A. strongly agree B. somewhat agree C. moderate D. somewhat disagree E. strongly disagree A. strongly agree B. somewhat agree C. moderate D. strongly disagree	1 0.75 0.5 0.25 0 1 0.75 0.5 0
A4	Is there an organization breakdown structure for waste management?	A. yes, well structured B. yes, informal C. no	0.87 0.72 0
A5	Is an education program for waste management	A. yes, periodical basis B. yes, once in while C. no	0.95 0.53 0

RESPONSE TABLE-3

5. RESULT AND ANALYSIS

It is a computer based waste management method. It is based on Microsoft excel, at first in this method. Input information like factor score, factor weight, and category weight are provided by us. Including project name, location and date of evaluation, factors response score are collected from face to face interview. Empirical relations are as follows

$$\text{TOTAL INDEX} = \sum_{i=1}^{4} \left(\sum_{j=1}^{l} \left(\sum_{k=1}^{m} \text{RSijk} * \text{RWijk} \right) * \text{FW}ij \right) * \text{CWI}$$

Where RS_{ijk}=score of kth response for jth factor in ith category; RW_{ijk}=weight of kth response for jth factor in ith category ($0<RWijk\leq 10$); CW_i=weight of ith category ($0 < CWi \leq 10$);

FW_{ij}=weight of jth factor in ith category ($0 < FW_{ij} \leq 10$);

l=number of factors in ith category; and= number of responses

For jth factor in ith category.

In quantitatively developing a measurable indicator, the system uses three different types of weights, including response, factor, and category. The computation for these weights is currently based on the industry survey and expert experience and knowledge. It is noteworthy; therefore, the tool results should be rigorously validated in terms of applicability and reliability of the outcome. Although the factors identified in this study come from a rigorous data collection, weight quantification falls short of extensiveness. One of the main reasons for this deficiency comes from the short history of familiarity to the environment in the construction industry compared to other issues of interest, such as time and cost savings.

By multiplying the option scores for each WMIF with the three types of weightings, the TI is easily obtained, and ranges from 0 to 1000

RESULT TABLE

category	factor	factor score(a)	factor weight(b)	value(c=a*b)	sum of value(d=∑c)	category weight(e)	category index(f=d*e)	total index(g=∑f)
man power	A1	3	18.18	54.54	358.74	0.22	78.9228	260.61
	A2	2	12.12	24.24				
	A3	5	30.3	151.5				
	A5	3	18.18	54.54				
	A7	3.5	21.12	73.92				
material and equipment	B1	2	14.81	29.62	238.85	0.26	62.0997	
	B2	3	22.22	66.66				
	B3	3	22.22	66.66				
	B7	2	14.81	29.62				
	B8	2	14.81	29.62				
	B9	1.5	11.11	16.665				
construction method	C1	3	20	60	273.32	0.24	65.5968	
	C2	2	13.33	26.66				
	C6	3	20	60				
	C7	3	20	60				
	C8	3	20	60				
	C12	1	6.66	6.66				
management practice	D1	2	14.28	28.56	192.81	0.28	53.9868	
	D3	1	7.14	7.14				
	D4	3	21.43	64.29				
	D5	1	7.14	7.14				
	D6	2	14.28	28.56				
	D9	2	14.28	28.56				
	D16	2	14.28	28.56				

RESUL TABLE- 4

RATING INDEX TABLE

INDEX RANGE	RATING	DESCRIPTION
801-1000	EXCELLENT	Waste management performance in this site is very effective in decreasing wastes and increasing recycling. Please keep attention to waste management.
601-800	GOOD	Waste management performance in this site is little effective in decreasing waste and increasing recycling. If you concern about weak part such as factor and category.
401-600	POOR	Waste management performance in this site is ineffective in decreasing wastes and increasing recycling. Please perform factors such as categories and factor having strong influence.
0-400	BAD	Waste management performance in this site is very ineffective in decreasing wastes and increasing recycling. Please establish or correct waste management plan of your site with referring this tool.

RATING INDEX TABLE-5

The result of this thesis is calculated different sites of Gwalior. It is an average result of all the building construction sites of Gwalior. In this result, we are noticed that the result came in the range of 0-400. Waste management performance in this site is very ineffective in decreasing wastes and increasing recycling. Please establish or correct waste management plan of your site with referring this tool.

We can calculate total index for a specific site so that we can check the level of performance for building construction site.

6. CONCLUSIONS

- Its case study for Gwalior area related to construction waste management.
- Here two pronged approach were identified first one is the identification of waste management influence factor and other is to check the level of waste management performance for building construction project.
- We are mainly focused on the planning or design phase with little emphasis on construction phase, the performance of building highly affect environment damage and economic loss.
- Good Sincerity by project practitioner like laborers subcontractors and general contractors, engineers and project manager are more important in effective waste management.
- Questionnaire survey has been conducted which is helpful for selection of optimum number of waste management influence factors.
- Empirical formula of total index is used for calculation of total index value; these values can be related with the waste management performance for building construction project.

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