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ANALYSIS ON PROJECT PORTFOLIO MANAGEMENT PRACTICES IN INDIAN CONSTRUCTION INDUSTRY

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Abstract — Project Portfolio management (PPM) is a combination of projects under the sponsorship of a particular construction organization sharing the scarce resources, managing projects and programs within the portfolio. It requires different strategies, models and practices. Many organizations across the country have projects in their sector in different places. However they abandoned temporarily suspended or closed within a decade which is troublesome. Proper PPM helps to execute the construction project effectively. As such, the aim of this research paper is to identify PPM practices in different construction organizations with a view to examine the effects of such practices on the project portfolio. The current research topic focuses on analysing the project performance of different construction projects using Project Portfolio Management practices. In this research a questionnaire survey related to the Project Portfolio Management on four major practices is carried out among the various professionals in Indian Construction Industry with help of Multi Criteria Decision Making (MCDM) techniques such as Entropy Method, SAW, CODAS methods and ranking the various project portfolio.

***Keywords*:** Project Portfolio management (PPM), construction industry, managing projects, multi criteria decision making (MCDM) techniques, entropy method, simple additive weighting (SAW) method, combinative distance based assessment (CODAS) method

1.0 INTRODUCTION

Project portfolio management (PPM) appears in various guises which integrates operating activities and projects of an organisation. PPM mainly applied in projects for prioritising the importance of Investments, managing the execution part, handling the risks and issues in the projects [1]. Simply strategies used in projects, in order to focus on the expectations of an organisation's investment strategy in all types of the projects. By targeting on a firm's entire portfolio of ongoing new product development projects, thus exceeding the single project focus. The organisation strategies in multiple projects bring their effectiveness by improving their outcomes [2].

The benefits of PPM practices in construction organisations adds value in linking the strategic goals when too many projects are in active stage. As new projects are continuously claim to be included in the portfolio practices, so as to emerge the technical opportunities. PPM can deliver additional benefits to an organisation beyond that of time, quality and Cost to enhance the actions within the organisation [3]. The recognition of PPM in complex construction projects should process according the management procedures and standards.

By determining the standards the effect of efficient portfolio management on capital growth is improved on significant effects. The global market today is driven by the demand for better cheaper, products and services which entails the classification of work projects where individuals are assigned responsibility to achieve specific objectives in construction projects within a given budget and by specified deadline [4]. Customers today are looking for high quality products at cheaper prices even if products are produced in a shorter time, so the construction projects are finished with a great planned management and approach for project portfolio. Thus PPM became key proficiency in implementing [5].

This is graspable to some extent, as currently the labour force is accessible and aims to supply most employment opportunities. With current developments and also the future interest of the many international organisations, however, thought must learn to adopt advanced strategies of planning and execution of its varied comes. The top-down approach revolves around that use of a rough order in magnitudes involving little explanations on how to estimate the needs of the resources [6]. The benefits in the long run are much more than the implantation costs in

the short run. This can set new standards, give firm structure to the business and create it a lot of economical and productive [7].

In some cases challenges faced by the industry, such as growth in response to increasing demands for goods and services; technological upgrading for speed, quality and cost reduction and the use of modern equipment. But by using modern management practices can improve profitability but the technical skills and financial strengths are required to withstand in the international market [8].The Flow Chart represents the procedure followed in the research paper as mentioned in Figure 1.

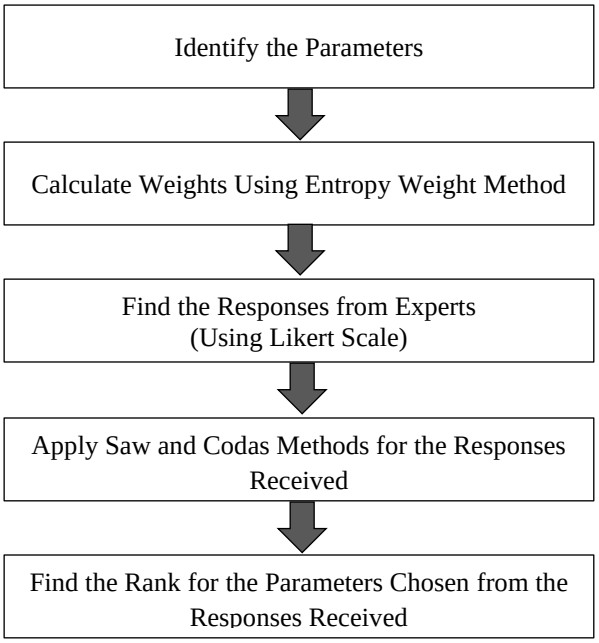

Figure 1 Flow Chart

2.0 METHODOLOGY

2.1 Methodology Description

The research is planned to be conducted in two phases, first phase is the preparation of the questionnaire on four important criteria of project portfolio management which includes Manpower Management, Regulatory Mechanism, Organising skills, Project Proposal related to Investment. This includes 27 questions were prepared with the help of construction Industry professionals. Questionnaire was circulated among the various stakeholders from the low-level site engineer to top level project managers. The responses for the questionnaire have been collected and will be analysed using the simple additive method (SAW) and Combinative Distance Based Assessment method (CODAS) methods. Before analysis weightage for each and every criterion is calculated using ENTROPY method in the second phase of the research. The analysis of the data was done through the formula to derive the results related to the PPM [9]. The results are expected to be useful for the Indian construction industry for improving the Project-strategies.

2.2 Data Analysis

2.2.1 Entropy Weight Method (Ewm)

Entropy weight method is a generally utilized as weighting technique, that estimates esteem scattering in dynamic. The more prominent the level of scattering, the more noteworthy level of separation, and more data can be inferred. In the interim, higher weight should be given to the record, and the other way around. This investigation shows that the soundness of the EWM in dynamic is sketchy [10]. One model is water source site choice, which is created by Monte Carlo Simulation. To begin with, too many zero qualities bring about the normalization aftereffect of the EWM being inclined to bending. Thusly, this result will prompt monstrous list weight with low genuine separation degree. Second, in multi-file dynamic including characterization, the arrangement degree can precisely mirror the data measure of the file. In any case, the EWM just considers the mathematical separation level of the record and

overlooks rank segregation. These two inadequacies show that the EWM can't effectively mirror the significance of the file weight, hence bringing about contorted dynamic outcomes [11].

In this method, m indicators and n samples are set in the evaluation, and the measured value of the i^{th} indicator in the j^{th} sample is recorded as x_{ij}.

The first step is the standardization of measured values. The standardized value of the i^{th} index in the j^{th} sample is denoted as P_{ij}, and its calculation method is as follows:

$$p_{ij} = \frac{x_{ij}}{\sum_{j=1}^{n} x_{ij}}. \tag{1}$$

In the EWM, the entropy value E_i of the i^{th} index is defined as

$$E_i = -\frac{\sum_{j=1}^{n} p_{ij} \cdot \ln p_{ij}}{\ln n}. \tag{2}$$

In the actual evaluation using the EWM, $p_{ij} \cdot \ln p_{ij} = 0$ is generally set when $p_{ij} = 0$ for the convenience of calculation.

The range of entropy value E_i is (0, 1). The larger the E_i is, the greater the differentiation degree of index i is, and more information can be derived. Hence, higher weight should be given to the index. Therefore, in the EWM, the calculation method of weight w_i is

$$w_i = \frac{1 - E_i}{\sum_{i=1}^{m} (1 - E_i)}. \tag{3}$$

2.2.2 Simple Additive Weighting (Saw)

Simple Additive Weighting (SAW) which is also known as weighted linear combination or scoring methods is a simple and most often used multi attribute decision technique. The method is based on the weighted average. An evaluation score is calculated for each alternative by multiplying the scaled value given to the alternative of that attribute with the weights of relative importance directly assigned by decision maker followed by summing of the products for all criteria chosen here [12]. The advantage of this method is that it is a proportional linear transformation of the raw data which means that the relative order of the SAW method requires the process of normalizing the decision matrix to a scale comparable to all current alternative ratings. This method is the most famous and most widely used method of dealing with Multiple Attribute Decision Making (MADM) situations. MADM itself is a method used to find the optimal alternative of some alternatives with certain criteria. The SAW method requires decision makers to assign weights to each attribute. The multi criteria decision making (MCDM) tools are good for ranking the selected criteria. The SAW and CODAS methods are part of MCDM techniques .The total score for the alternative is obtained by summing all the results of the multiplication between the rating and the weight of each attribute. The rating of each attribute must be dimensionless; it has passed the previous matrix normalization process.

The basic concept Simple additive weighting method is to find the sum of the weighted performance rating for each alternative on all attribute [13].

It requires a process of normalizing the decision matrix (X) to a scale that can be compared with all the ratings of existing alternatives.

$$r_{ij} = \frac{x_{ij}}{Max(x_{ij})} \tag{4}$$

The weights of all criteria are obtained by using entropy method. Evaluating each alternative by mentioned formula:

$$V_i = \sum_{j=1}^{n} W_j \; r_{ij} \tag{5}$$

Where,
V_i = Ranking of each alternative
w_j = Weighted value of each criterion
r_{ij} = Normalized performance rating value

2.2.3 Combinative Distance-Based Assessment (Codas)

CODAS method is also multi criteria decision making technique. In this method, the desirability of alternatives is determined by using two measures. The main and primary measure is related to the Euclidean distance of alternatives from the negative-ideal. Using this type of distance requires an -norm indifference space for criteria. The secondary measure is the Taxicab distance which is related to the -norm indifference space. It's clear that the alternative which has greater distances from the negative-ideal solution is more desirable [14]. In this method, if we have two alternatives which are incomparable according to the Euclidean distance, the Taxicab distance is used as secondary measure. Although the -norm indifference space is preferred in the CODAS, two types of indifference space could be considered in its process [15, 16].

Step 1: Constructing decision matrix and the decision matrix will be normalized by the mentioned formula:

$$r_{ij} = \frac{x_{ij}}{Max(x_{ij})} \tag{6}$$

Step 2: Calculating the weighted normalized decision matrix. The values of the weighted normalized performance are calculated as mentioned below:

$$r_{ij} = w_j n_{ij} \tag{7}$$

Where, w_j = weight of j^{th} criteria

Step 3: Determining the negative – ideal solution

$ns = [ns_j]_{1xm}$

$ns_j = \min r_{ij}$

Step 4: Calculate the Euclidean and taxicab distance of alternatives from the negative – ideal solution, as mentioned below:

$$E_i = \sqrt{\sum_{j=1}^{m} (r_{ij} - ns_j)^2} \tag{8}$$

$$T_i = \sum_{j=1}^{m} |r_{ij} - ns_j| \tag{9}$$

Step 5: Calculating the relative assessment matrix as shown below:

$$Ra = [h_{ik}]_{n \times n} \tag{10}$$

$$h_{ik} = (E_i - E_k) + \left(\psi(E_i - E_k) \times (T_i - T_k)\right) \tag{11}$$

Step 6: Finding the assessment score of each alternative, as mentioned below:

$$H_i = \sum_{k=1}^{n} h_{ik} \quad (12)$$

Step 7: Ranking the alternatives with respect to the values of assessment. The highest value of assessment will be choice as the best alternatives.

3.0 RESULTS & DISCUSSIONS

All the 27 questions prepared and floated to various construction professionals and asked then for provide the response in the Likert scale of 1-5 (Very low to very high).

Table 1 Questionnaire Survey Responses

Questionnaire Survey Responses						
Sl.No	**Description**	**Very High = 5**	**High =4**	**Medium =3**	**Low =2**	**Very Low =1**
1	Selecting Right Person for the Right Job	23	20	11	1	0
2	Providing the adequate information about the organisation and assigning the work at the time of recruitment	12	27	13	2	1
3	Selection of the hierarchy by their work performance and knowledge in industry	17	24	11	2	1
4	Is Frequent Training to employees in PPM Techniques are required?	17	25	8	2	3
5	Does the training program conducting in PPM methods useful in handling resources?	16	24	11	0	4
6	Projects, programs, and portfolios are managed by a specialized organizational unit	11	22	17	4	1
7	Whether the Management processes are well documented and controlled?	16	27	11	1	0
8	Project management processes are standardized and subjected to improvements	18	21	15	1	0
9	Project management processes are measured in terms of quality	21	22	9	3	0
10	Whether the Project management processes are subject to continuous updation?	16	28	10	1	0
11	Does all the projects are using same project management methods	10	16	17	9	3
12	Is stakeholder participation during project life cycle appreciated in your organisation?	10	19	17	5	4
13	Whether the temporary organisation structure creation helps in the performance of project?	8	18	21	7	1
14	Does the execution of major projects improve the organisational reputation?	25	24	6	0	0
15	Application of PPM methods over selection of projects is useful	9	34	10	2	0
16	Communication barrier between same hierarchical level	7	17	20	6	5
17	Whether the PPM methods are helpful in engagement with stakeholder?	11	20	20	4	0
18	Involvement of Top management in monitoring and controlling phase of the project	17	26	9	3	0
19	Project managers are insisting to follow organizational processes and procedures	19	24	9	3	0
20	Project managers are requested to document lessons learned and apply them to future projects	19	25	9	2	0
21	Whether the Project managers are adapting PPM method with respect to features and environmental conditions of individual project?	10	25	15	5	0
22	How much the distribution of individual project value and benefits among portfolio stakeholders affect project?	8	24	14	7	2
23	Is project portfolio achieving sustainable financial results?	12	27	14	2	0
24	How important is setting up an accurate budget?	24	22	7	2	0
25	How much PPM technique helps to estimate the Profitable yiels in the projects?	12	30	10	3	0
26	Is PPM technique improving the transparency of projects for the investment by stakeholders?	10	28	15	2	0
27	How much PPM helps in analysing Portfolio and reallocation of funds in the Project?	11	31	12	1	0

The consolidated response score is recorded and tabulated in the Table 1.

About 113 number of questionnaires were distributed among the employees, out of which 58 numbers (not returned) and 55 numbers (returned) about 48.67 percentage responses acquired. The above-mentioned Table 1 shows the collected data of PPM practices based on the perceptions of various professionals working in the industry [17, 18].

After obtaining the responses now Combinative Distance-Based Assessment (CODAS) method is applied as per the procedure mentioned in the above. Now CODAS value for each parameter is calculated and rank is tabulated as per CODAS value in Table 2.

Similarly for the same parameters adopted in this research study values mentioned in the Table 1 now the Simple Additive Weighting (SAW) technique is applied, SAW value is calculated and SAW ranking is tabulated table 2. Now the comparison of CODAS Rank and SAW rank was tabulated in Table 2.

Similarly for the same values mentioned in the Table 1 now the Simple Additive Weighting (SAW) technique is applied, SAW value is calculated and SAW ranking is tabulated table 2.Now the comparison of CODAS Rank and SAW rank was tabulated in Table 2.

Table 2 Analysis on project portfolio management by SAW & CODAS method in Indian construction industry

Sl.No	DESCRIPTION	CODAS Value	CODAS Ranking	SAW Value	SAW Ranking
1. MANPOWER MANAGEMENT					
1	Selecting Right Person for the Right Job	0.061	2.00	0.695	2.00
2	Providing the adequate information about the organisation and assigning the work at the time of recruitment	0.082	1.00	0.704	1.00
3	Selection of the hierarchy by their work performance and knowledge in industry	-0.080	5.00	0.594	5.00
4	Is Frequent Training to employees in PPM Techniques are required?	-0.046	4.00	0.615	4.00
5	Does the training program conducting in PPM methods useful in handling resources?	-0.017	3.00	0.616	3.00
2. REGULATORY MECHANISM					
1	Projects, programs, and portfolios are managed by a specialized organizational unit	-0.221	7.00	0.697	6.00
2	Whether the Management processes are well documented and controlled?	0.050	5.00	0.826	5.00
3	Project management processes are standardized and subjected to improvements	0.201	3.00	0.849	3.00
4	Project management processes are measured in terms of quality	0.180	4.00	0.848	4.00
5	Whether the Project management processes are subject to continuous updation?	0.242	2.00	0.873	2.00
6	Does all the projects are using same project management methods	-0.285	9.00	0.623	9.00
7	Is stakeholder participation during project life cycle appreciated in your organisation?	-0.182	6.00	0.640	7.00
8	Whether the temporary organisation structure creation helps in the performance of project?	-0.285	8.00	0.628	8.00
9	Does the execution of major projects improve the organisational reputation?	0.309	1.00	0.937	1.00
3. ORGANISING SKILLS					
1	Application of PPM methods over selection of projects is useful	0.066	4.00	0.777	4.00
2	Communication barrier between same hierarchical level	-0.587	7.00	0.491	7.00
3	Whether the PPM methods are helpful in engagement with stakeholder?	-0.082	5.00	0.731	5.00
4	Involvement of Top management in monitoring and controlling phase of the project	0.257	2.00	0.851	2.00
5	Project managers are insisting to follow organizational processes and procedures	0.098	3.00	0.842	3.00
6	Project managers are requested to document lessons learned and apply them to future projects	0.341	1.00	0.911	1.00
7	Whether the Project managers are adapting PPM method with respect to features and environmental conditions of individual project?	-0.084	6.00	0.721	6.00
4. PROJECT PROPOSAL RELATED					
1	How much the distribution of individual project value and benefits among portfolio stakeholders affect project?	-0.335	6.00	0.608	6.00
2	Is project portfolio achieving sustainable financial results?	0.054	3.00	0.792	3.00
3	How important is setting up an accurate budget?	0.212	1.00	0.918	1.00
4	How much PPM technique helps to estimate the Profitable yiels in the projects?	0.061	2.00	0.796	2.00
5	Is PPM technique improving the transparency of projects for the investment by stakeholders?	0.064	4.00	0.789	4.00
6	How much PPM helps in analysing Portfolio and reallocation of funds in the Project	-0.052	5.00	0.787	5.00

3.1 Discussion on Results

The chart in Figure 2 showing the comparison of the SAW amd CODAS ranking of PPM practices in Manpower Management, Regulatory Mechanism, Organising Skills, Project Proposal Related to Investment[19, 20] respectively. The Figure 2 (four important criteria of project portfolio management which includes Manpower Management, Regulatory Mechanism, Organising skills, Project Proposal related to Investment) represents number of paramneters choosen in each criteriaVs rank in codas and saw are portrayed in Figure 2. For example to reprsent manpower mangement, in the Figure 2 x-axis represents the number of parameters choosen as per Table 2 in the manpower management i.e 5 and y-axis represents rank using codas and saw method i.e from rank 1 to rank 5. Hence the entire Figure 2 represents the parameters choosen in this questionaire study is regulating mechanism, organising skills and project proposal investment as mentioned in Table 2. The results also shows that both methods are providing the same rank for the parameters choosen it is evident in Table 2 and in Figure 2.

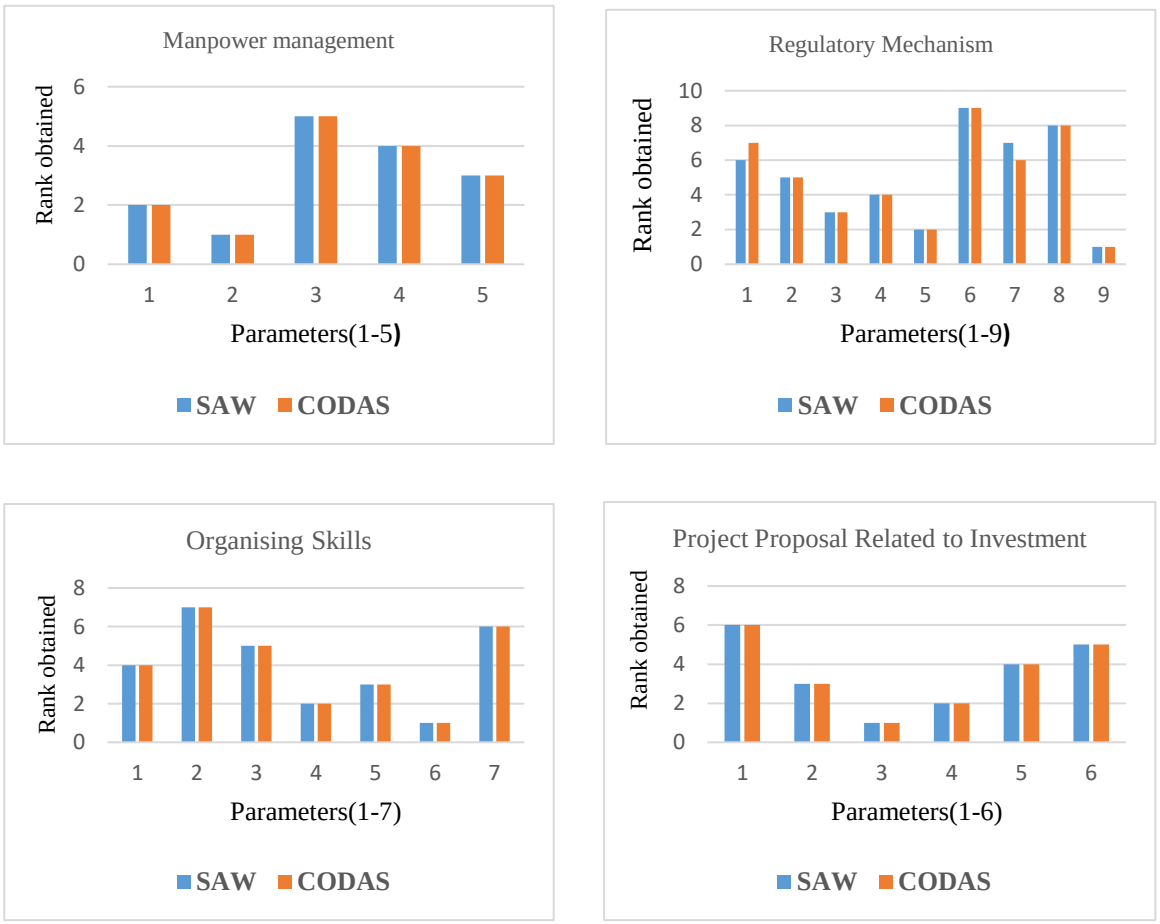

Figure 2 Comparison of various portfolios using SAW and CODAS method using bar chart

4.0 CONCLUSION

The current research identifies 27 PPM practices in construction industry and results in terms of ranking were portrayed. As per simple additive method (SAW) method, the execution of the major project will increase the reputation of industry has ranked 1st in the criteria of regulatory mechanism with greater value. As per the Combinative Distance-Based Assessment (CODAS) method documentation is the lesson learned and applying them in future projects is ranked 1st in the criteria of organising skills. The overall analysis of this research portrays that, all the PPM practices are significantly effective in terms of following good practices in Construction Industry. When the work is assigned to new people the organization should clearly mention the details of the project and should verify the capabilities of the people before the work is assigned to them. The same was analysed and ascertained using SAW and CODAS method in this paper. If these PPM practices are effectively employed and practiced the overall performance will have positive impact for achieving the organizational objectives easily. The

PPM practices are very much useful in analysing the performance of the projects, also important parameters are listed for future reference while executing the projects. This analysis is helpful to identify the pitfalls in the construction projects and can be rectified.

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