NIPES

Journal of Materials Engineering, Structures and Computation

Journal homepage: www.nipesjournals.org.ng

A Factorial Approach of Improving Information Management In Project Execution And Control In NDDC

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ARTICLE INFORMATION

Article history:
Received 13 November 2023
Revised 31 December 2023
Accepted 31December 2023
Available online November 2023

Keywords:
Project, Factor loading, Varimax rotation, likert scale, Information management

https://doi.org/10.5281/zenodo.10474133

ABSTRACT

In this work, the critical factors in improving information management in project execution and control in NDDC were identified. The study employed a survey approach, with questionnaires designed to gather data about information systems usage and the attendant effects. Factor analysis was applied to the identified variables. Kendall's Coefficient of Concordance (KCC) and Principal Component Analysis (PCA) were used to analyze the data collected from respondents, rank the established variables, and reduce these variables. And also to investigate the interplay among these variables. The results showed the rating by experts who ranked the factors and showed that the index of consistency in ranking with 0.962 and is considered robust which suggests a great coherence in their ranking with communication strategies coming up trump in the analysis. The PCA model clustered the thirty-two factors into five factors through data reduction and it was found that site meetings, feedback system, Local culture, project communication management and Staff training, are among the critical factors identified. This study has been able to find out that relationships exist between information systems usage and perceived poor service delivery of projects.

1. Introduction

Information management mean deploying a new technology such as content or document management systems, data base management system or portal applications. Improving information management practices is a key focus for many organizations. Information is being driven by a range of factors, including a need to improve the efficiency of business processes, the demands of compliance regulations and the desire to deliver new services. Efficiency in project execution and control depends upon the quality of relationship between the clients, professionals, contractors and

sub-contractors [1]. The various stages in project execution and control rely on professionals transferring appropriate and relevant information to develop a design that meets the client's requirements [2. Communication is an important element for every organization to succeed. Organizations cannot exist without communication, and management will not be able to receive information inputs, and supervisors would not be able to give instructions, coordination of work is impossible and the organization will collapse for lack of it [3. In other words, the problems in construction are a communication problem [4]. Participants need to collaborate, share, collate, and integrate significant amounts of information in order to realize project objectives [4]. According to Titus and Bröchner, [3], information dissemination plays a profound role in a construction environment whether during the preconstruction period or the project implementation. During all stages of construction such as design, production, organization and management, communication is paramount/ important in order to realize the construction processes [5]. Construction project management requires effective communication among project stakeholders for successful project delivery [6]. During construction project, irrespective of the size of the project, communication between the user (client), contractor and other parties involved in the project plays a vital role in order for the project to be realized [7]. Lack of effective communication between project stakeholders is one of the major causes of delay which results in abandonment of project in Nigerian construction projects [8]. Poor communication between project participants such as the client and contractor is one of the factors that affect the working efficiency; it is the reason for relatively low productivity of the construction industry [9-10]. Murali and Yau [11] stated that the problem of communication within a project environment leads to severe misunderstanding between client and contractor and this affects the execution of the project. This work aim at investigating the critical factors for improving information management in project execution and control in NDDC through identification and analysis of factors that constitute constraints to a successful construction project.

2.Methodology

The study adopted a survey approach with the use of questionnaires with five-point Rensis Likerts attitudinal scale. The respondent responses were transferred into metric variables. This respondent's score was collated as data matrix of thirty-two by seventy-three (32 × 73). The data matrix was fed into StatistiXL software which generated correlation matrix, eigenvalues and eigenvectors, descriptive statistics results, unrotated and varimax rotated factors, scree plot and factor plot of the thirty two (32) variables. Factor loadings with acceptable values were highlighted which yielded five (5) factors. The factors were creatively labelled, interpreted and used as decision making. The unrotated factors obtained that could not be interpreted and so varimax rotation became necessary. Factor loadings in the factor matrix below the threshold of 1 were also discarded.

The following assumptions about factor analysis based on postulations in [13-15] were made:

a) Normality (shape of data distribution for individual matrix variable)
b) Homoscedasticity (equal dispersion of variance across variables) and
c) Linearity (columns of data matrix as seen as column vectors with linear characteristics which can diminish correlation.

2.1 Model Employed

The statistical models employed in this work were Kendall's Coefficient of Concordance and Principal Component Analysis.

2.1.1 Kendall Coefficient of Concordance

The mathematical theories that govern the software statistical analysis [16] are sketched hereunder:

a. Number of scale items to be ranked = N and number of judges assigning ranks = K
b. Inputting the assigned rank into K*N matrix
c. For each entity obtain R_j, which is the total scores for each of the scale item
d. Obtain the mean of the various R_j's, where j refers to the variable response from the judges on scale item, i??
e. Obtain the deviation of every R_j from the computed mean of R_j
f. Obtain the square of the deviation of each of the scale items??
g. Compute the Kendall Coefficient of Concordance (W), expressed in Equation (1)

Kendall coefficient of concordance measures the degree of agreement between the judges

$$W = \frac{12S}{K^2(N^3-N)} \quad (1)$$

N = Total number of Variables, s = Variance, K = Number of Judges

Where $s = \sum\left(R_j - \frac{\sum R_j}{N}\right)^2$ = Rank variance (2)

R_j = Column sum of ranks

The KCC is useful in establishing merit order sequence of the influential accident variables.

2.1.2 The governing equation on the application of the Principal Component Analysis

Let X_{ij} and Y_{ij} represent a pair of variables in the data matrix. Then column mean is expressed as

$$\bar{X}_{.j} = \sum_{i=j}^{N} \frac{X_{ij}}{n_j} \quad (3)$$

$$\bar{Y}_{.j} = \sum_{i=j}^{N} \frac{Y_{ij}}{n_j} \quad (4)$$

Then $x = X_{ij} - \bar{X}_{.j}$ and $y = Y_{ij} - \bar{Y}_{.j}$,

Where i and j refers to the state of the matrix, x and y refers to the respective mean deviation or deviation from the mean. Hence, the Correlation coefficient, r_{ij} is expressed as

$$r_{ij} = \frac{\sum xy}{\sqrt{(\sum x^2).(\sum y^2)}} \quad (5)$$

$x = X_{ij} - \bar{X}_{.j}$

$y = Y_{ij} - \bar{Y}_{.j}$,

$$\bar{X}_{.j} = \sum_{i=j}^{N} \frac{X_{ij}}{n_j}$$

$\bar{Y}_{.j} = \sum_{i=j}^{N} \frac{Y_{ij}}{n_j}$,

When r_{ij} is computed from equation (6) ${}^{n}C_2 = \frac{n!}{(n-2)!2!}$. (6)

3. Results and Discussion

This section focuses on presentation of data for research and give a detailed mathematical analysis that give rise to the results.

The thirty-two variables were ranked by the thirteen judges in merit order sequence. Accordingly, the ranking of variables is presented in Table 1

Table 1. Ranking of Variables

S/N	Rj	Variables	S/N	Rj	Variables
1.	**36**	Communication strategies	17	**251**	Meetings
2.	**39**	Clear Communication	18	**251**	Training Of Operatives
3.	**86**	Site Meetings	19	**257**	Language Used
4.	**98**	Existence Of Poor Planning	20	**263**	Members Of The Team
5.	**133**	Pressure Of Business Partners	21	**264**	Signs and Symbols
6.	**137**	Local Culture	22	**268**	feedback system
7.	**153**	Communication Barriers	23	**286**	service delivery
8.	**155**	Project Communication Management	24	**291**	Project Management Software
9.	**155**	Representation Of Facts	25	**298**	Effective Communication Strategies
10.	**164**	Unclear Objectives	26	**301**	Project Proponents And Stakeholders
11.	**167**	Staff Trainings	27	**306**	Project Cost
12.	**182**	Feedback System	28	**316**	Communication Plan
13.	**182**	Service Delivery	29	**324**	Communication Media
14.	**198**	Cost Of Technology	30	**344**	Ineffective Reporting Systems
15.	**209**	Information Security	31	**344**	Adequate Communication
16.	**247**	Training Of Operatives	32	**686**	Project Implementation

Kendall coefficient of concordance W is given by: $W = \frac{S}{\frac{1}{12}K^2(N^3-N)}$

$$S = \sum \left(R_j - \frac{\sum R_j}{N} \right)^2$$

R_j = Column sum of ranks = 7386

N = 32

S = Variance

From Factor Ranking Matrix,

$$\sum R_j = 20{,}640$$

$$\frac{\sum R_j}{N} = \frac{20{,}640}{32} = 396.9231$$

$$s = \sum \left(R_j - \frac{\sum R_j}{N} \right)^2 = 253{,}653{,}8$$

$$W = \frac{253{,}653{,}8}{\frac{1}{12} \times 13^2(32^3 - 52)} = \frac{253{,}653{,}8}{263{,}542{,}5} = 0.962477$$

Also, χ^2_{cal} = K (N – 1) W

K = 13, N = 32, W = 0.962477, $\chi^2 = 13(32-1)0.9624 = 736.23$

H_0: mean the ranking of the thirteen (13) judges are not in agreement,

H_1: mean the ranking of the thirteen (13) judges are in agreement.

From the results, $x^2_{cal} = 736.236 > x^2_{tab} = 68.66$, our experimental data do not provide sufficient evidence to accept the null hypothesis of discordance among the judges who did the ranking. Thus, the null hypothesis, Ho was rejected at a p-value of 0.05, implying that the judges ranking was in concordance, with W = 0.962477 (which is meritorious) implies that 96.2477% of judges were in agreement.

The PCA reduced the thirty-two (32) variables into Five (5) dimensions. Varimax rotation made this reduction possible. The scree plot showing the relationship between the eigenvalues and the variables is shown in Figure 1. The plot of extracted thirty-two factors were generated using StatistiXL software as shown in Figure 1. It is obvious from the scree plot that at eigenvalue of 1, and component number five (5), the curvity flattens out, suggesting that five factors extracted were adequate.

Table 3 -7 shows the cluster of the Variables and their creative labelling

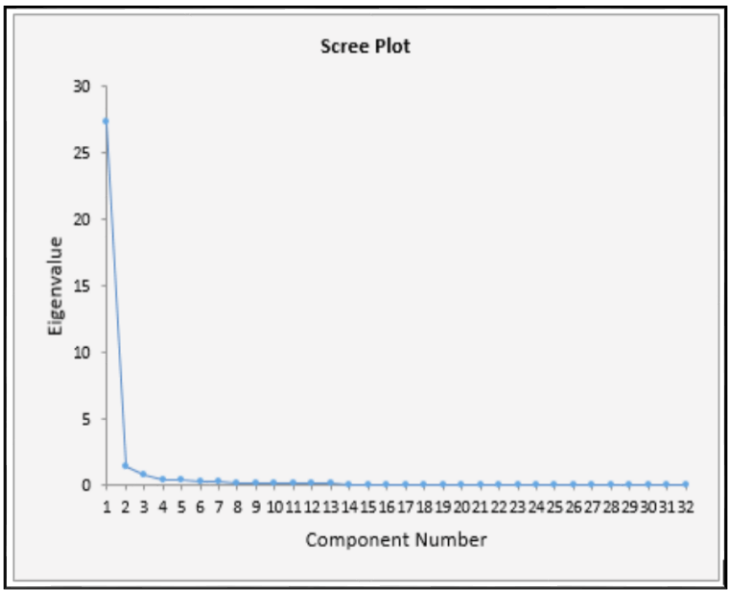

Figure 1. Scree plot of the Variables

Table 2. Varimax Rotated Values.

Varimax Rotated Factor Loadings Matrix of 32 Variables of Information Management						
S/N	**Variable**	**Factor 1**	**Factor 2**	**Factor 3**	**Factor 4**	**Factor 5**
1	Site Meetings	0.516	0.385	0.316	0.684	0.097
2	Training of Operatives	0.815	0.463	0.228	0.057	0.103
3	Language used	0.452	0.776	0.255	0.236	0.134
4	Communication Strategies	0.594	0.437	0.380	0.266	0.333
5	Clear Communication	0.530	0.742	0.207	0.137	0.126

6	Meetings	0.540	0.724	0.300	0.142	0.067
7	Communication Plan	0.811	0.465	0.208	0.150	0.144
8	Communication Media	0.543	0.737	0.222	0.185	0.081
9	Local Culture	0.739	0.376	0.245	0.359	0.033
10	Communication Barriers	0.527	0.555	0.458	0.193	0.181
11	Project Communication Management	0.830	0.425	0.211	0.165	0.144
12	Adequate Communication	0.723	0.344	0.355	0.268	0.113
13	Project Implementation	0.405	0.597	0.619	0.223	0.114
14	Staff Trainings	0.382	0.793	0.312	0.246	0.146
15	Feedback System	0.411	0.826	0.260	0.107	0.121
16	Service Delivery	0.819	0.433	0.214	0.192	0.109
17	Cost of Technology	0.624	0.500	0.361	0.093	0.426
18	Partners Understanding	0.426	0.667	0.238	0.115	0.149
19	Effective use of Technology	0.787	0.480	0.270	0.100	0.134
20	Members of the Team	0.790	0.498	0.233	0.101	0.078
21	Existence of Poor Planning	0.771	0.384	0.264	0.263	0.244
22	Pressure of Business Partners	0.506	0.776	0.212	0.157	0.089
23	Information Security	0.461	0.584	0.561	0.233	0.123
24	Project Management Software	0.592	0.469	0.383	0.176	0.468
25	Effective Communication Strategies	0.470	0.786	0.234	0.124	0.106
26	Project Proponents and Stakeholders	0.783	0.380	0.267	0.254	0.031
27	Project Cost	0.312	0.599	0.694	0.176	0.105
28	Representation of Facts	0.395	0.721	0.334	0.165	0.174
29	Unclear Objectives	0.667	0.344	0.374	0.320	0.126
30	Ineffective Reporting Systems	0.398	0.710	0.419	0.204	0.124
31	Signs and Symbols	0.418	0.789	0.297	0.232	0.133
32	Training of Operatives	0.725	0.567	0.182	0.168	0.022

Factors Interpretation

The Table 3 below depicts the variables loaded under the various clusters.

Table 3. Factor 1 (F_1) Information Culture.

S/N	Variable Description	Factor Loading
2	Training Of Operatives	0.815
4	Communication Strategies	0.594
7	Communication Plan	0.811
9	Local Culture	0.739
10	Communication Barriers	0.527
11	Project Communication Management	0.830
12	Adequate Communication	0.723
16	Service Delivery	0.819
17	Cost Of Technology	0.624
19	Effective Use Of Technology	0.787
20	Members Of The Team	0.790
21	Existence Of Poor Planning	0.771
24	Project Management Software	0.592
26	Project Proponents And Stakeholders	0.783
29	Unclear Objectives	0.667
32	Training Of Operatives	0.725

Factor analysis also was performed on the thirty-two (32) independent variables. PCA was employed, and with the aid of StatistiXL software, generated five (5) clusters. A principal factor comprises of sixteen (16) variables were creatively labelled. The variables all bear positive factor loadings suggesting that it was a sturdy factor. Eighteen (18) variables emerged top in the list based

on their high factor loadings. Factor 1 which was Information Culture comprises of 18 items with factor loadings ranging from 0.500 to 0.826, Factor 2 which was Miscellany components comprises of Five (5) items with factor loadings ranging from 0.644 to 0.834. Factor 3 which was Effective communication consist of three (3) items with factor loadings ranging from 0.593 to 0.801 followed by Factor 4 which was top Information Technology consist of Five (5) items with factor loadings ranging from 0.620 to 0.823. Factor 5 which was Communication scope comprises three (3) items with factor loading ranged from 0.517 to 0.791.

Table 4. Factor 2 (F_2) Miscellany components

S/N	**Variable description**	**Factor loading**
3	Language used	0.776
5	Clear communication	0.742
6	Meetings	0.742
13	Project implementation	0.597
14	Staff training	0.793
15	Feedback system	0.826
18	Partners understanding	0.607
22	Pressure of business partners	0.776
23	Information security	0.584
24	Project management software	0.569
25	Effective communication strategies	0.786
28	Representation of facts	0.721
30	Ineffective reporting systems	0.710
31	Signs and symbols	0.789

The factors here are multifarious. They are between middling and substantial factor loadings.

Table 5. Factor 3(F_3) Effective communication

S/N	Variable description	Factor loading
3	Local Culture	0.694
1	Site Meetings	0,684

Here, we have a dual factor that was creatively labelled as Effective communication. It comprises of local culture and Site Meetings. This was because Effective communication affect the duration of project completion. Let us look at project mission where clear project objectives and directions are made known to the project team through some form of communication. Besides that, top management in NDDC also demonstrates support through communication to the project by responding to the resource needs requested by the team. The communication element is also present in the personnel and client acceptance factor.

Table 6. Factor 4 (F_4) Information Technology

S/N	**Variable description**	**Factor loading**
17	Cost of information technology	0.694
24	Feedback system	0.468

Table 7. Factor 5(F_5) Communications Scope

S/N	**Variable description**	**Factor loading**
13	Communication barriers	0.526
23	Communication strategies	0.561

The findings of this study shows that project communication management have influence on project success. A competent project team comprises of a project leader with its members, who are well trained and possessed the required skills, knowledgeable and experience to execute a project. The results from this study is also in line with Dave *et al*[12] who pointed out that people are involved in every process and human dimensions exist in nearly all critical factors related to the project success including the duty to determine the adequacy of each process that has been carried out. Result also showed that 'site meetings' has relationship with project success. The reason was that respondents comprises of a project leaders and members, therefore represent the voice of the clients in which the project is designed for and opinions of every member should be welcomed.

4.Conclusion

The Kendall coefficient of concordance (W) was found to be 0.96277 is considered meritorious, meaning that there was an agreement among the judges that ranked the variables. Consequently, a null hypothesis claiming that the ranking of the factors by thirteen (13) judges is discordant was rejected at a p-value of 0.05. thus suggesting that the computed index of consistent ranking is meritorious. The implication of the re-ordering of these variables by the judges is that the problems can be hierarchically arranged in terms of management attention. The ranking of the variables imply that management should pay more attention to the issues raised according to their severity. The Principal Component Analysis models employed was quite successful in achieving parsimony by reducing the thirty-two (32) established variables to mere five (5). This is indeed a significant parsimony in factor reduction. It also established the inter correlations among the variables.

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