

# Assessing the Impacts of Project Interfaces in Construction Works in Nigeria

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**Abstract:** *Interface management problems inherent in construction projects hamper their successful delivery. Therefore, this study aimed at determining the most important project interfaces in construction works in Nigeria in terms of most significant potential impacts, so that management attention are objectively focused on potential highest impacting project interfaces. From a review of literature, 28 project interfaces management issues were identified and categorized. Structured questionnaires were used to collect data concerning the impact (estimated losses to the project in terms of cost) and probability of occurrence of the identified interfaces. The interfaces were ranked using their computed Matrix Scores (MS). The results reveal that “project-workers interfaces problem manifested in use of inappropriate mixes” is the highest impacting. A ranking of the interface categories also reveal that the interfaces at the execution phase of a project (MS = 1226.79) are those that could result in the highest losses to the project.*

**Keywords:** *Project Interfaces; Interface Management; Matrix score; Construction projects; Nigeri*

## I. INTRODUCTION

The construction industry is one of the most important economic activities of any nation in terms of its contribution to economic growth [1]. However, because of the multi-disciplinary nature of construction projects [2], they often have numerous interface management issues [3]. Project Interfaces are simply defined as the points of contact or interaction between project components or parties. According to [4], some manifestation of Interface Management problems in Nigeria are; significant delay in commencement of work, misunderstanding and lack of cooperation, parties having different expectations from negotiated contracts, non application of correct material mix in construction projects, excessive reworks, and misinterpretation of working drawings. Other interfaces problems identified by [3] are; design errors, part mismatch, system performance failures, coordination difficulties, and construction conflicts. Apart from these light cases, investigations have highlighted Interface Management failures as the root cause or compounding cause of some major project disasters which claimed countless human lives and huge insurance settlements, as well as resulted in abandonment of the projects [5].

Given these undesirable effects of interface management problems, it is imperative to effectively manage project interfaces so as to ensure that project objectives are realized. According to [4], there are numerous interfaces in every kind of projects. Effective management of these project interfaces calls for not just identification of all interfaces, but also prioritizing the interfaces so that management effort can be directed first to the interfaces with highest priority (impacts). Therefore, the objectives of this paper are:

- To determine the most important project interfaces in construction works in Nigeria in terms of most significant potential impacts.
- To identify the most important phase in the project life cycle of Nigerian construction works in terms of highest impacting interfaces

The determination of the significance of project interfaces and the ranking of the project interfaces will enable management to properly allocate limited resources towards the potential highest impacting project interfaces, thereby improving the likelihood of project success and delivery.

## II. THEORETICAL FRAMEWORK

Effectively managing project interfaces is essential to successful construction management [3] and successful project delivery. This knowledge has lead to a lot of researches into the subject of project interface, specifically the identification of most significant interfaces, and identification of effective interface management approaches [3]; [6]; [7]; [8]; [9]; [10].

### A. Literature on Interface Management Approaches

It is stated in [8] that people see Interfaces problems largely as social issues and as such attempts to manage project interfaces take a social dimension. The authors proposed holding of series of meetings with project stakeholders before and during project execution, with the project manager playing the important role of exploring the expectations of key stakeholders and aligning them

They also noted that documentation should be employed in managing systems interfaces; whereby the workings, conditions and assumptions of the various sub-systems are documented in detail so that they can be easily

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assembled and operated as a unit. The work of [3] further explored documentation as a method of interfaces management, and they gave the following documents as important tools in project interface management – Structural Electrical Mechanical (SEM) drawing, Combined Service Drawing (CSD), Interface Control Document (ICD), Problems and Efforts Report, etc. [9] proposed using a Work-Breakdown-Structure (WBS) in managing interfaces. The authors argued that by breaking the projects into its smaller component pieces, the interfaces risk issues can be clearly identified and managed. The research of [10] attempted using causal linkages to quantify impacts of project changes by linking project participants with their interactions. It was proposed by [4] that Probability and Impact Matrix (PIM) should be used to manage project interfaces; the study claimed that the PIM as a quantitative tool quantifies the potential impact of project interfaces, as such management attention are objectively directed to the highest impacting interfaces.

### B. Literatures Identifying Significant Project Interfaces

“Project Manager/Project interface issues relating to poor coordination of works” and “project team interface issues manifested in poor information exchange” are considered by [11] as having potential high impacts on construction projects. In the study of [12], interfaces management issues between project designers and contractors are said to be highly significant in terms of potential impact on construction projects. This is because an occurrence of such interface management issue could result in designs to be synchronized not being interoperable. The multiplier effect is misinterpretation of designs, execution of incompliant works and excessive reworks. In his study, [13] opined that interface between contractor and sub-contractors has potential high impacts on construction projects. This was consistent with the opinion of [14] in their own study. The management failure of this interface could result in, among other undesirable things, delays in intermediate project deliverables. The study of [7] also investigated causes of interface issues from six interrelated perspectives and discovered that interfaces relating to people / participants, methods / processes, resources, documentation, project management, and environment all have potential high impact on construction projects.

### III. METHODOLOGY

Using structured questionnaires, primary data was collected to assess the significance of project interfaces in construction works in Nigeria. Following an extensive review of existing literature, a total of twenty-eight interfaces management issues that can potentially affect the successful delivery of construction projects were consolidated into the questionnaires, which was administered to three target groups (Project Managers, Project Consultants, Contractors/ Subcontractors) actively involved in construction projects in Nigeria. The questionnaires were structured to solicit responses from the

respondents about their perception of two parameters relating to the identified interfaces management failures: the probability of their occurrence, and their potential consequence (impact) on the project in the event of their occurrence.

The probability of occurrence of the interface issue ranges from 0% – 100%. Following the model of [15], the points on the probability scale can be explained as follows:

- 0 – 10%: very low probability risk level
- 11 – 40% : low probability risk level
- 41 – 60%: medium probability risk level
- 61 – 90%: high probability risk level
- 91 – 100%: very high probability risk level.

Similarly, the impact of the interface issue is defined in potential financial losses to the project (in term of total project cost). The impact scale used range from 0% to infinity. The points on the impact scale can be explained using the following:

- Disastrous consequences: above 65% of the total project cost.
- Serious consequences: between 46 – 65% of the total project cost.
- Moderate consequences: between 21 – 45% of the total project cost
- Minor consequences: between 6 – 20% of the total project cost.
- Negligible consequences: 5% of the total project cost.

Simple mathematical averages were used to process the data collected from the questionnaire survey. For each interface issue, the probability and impact is obtained by summing all respondents’ scores and dividing by the total number of respondents. To determine the most important project interfaces in terms of most significant potential impacts, the expected value (matrix score) which is the product of the probability and potential impact of the interface issue (risk event) are calculated and used to rank them. The Matrix score is simply computed as follows:

$$\text{Matrix Score} = P \times I$$

(Where: P = probability of occurrence of interface management issue; I = potential Impact of the interface management issue in the event of occurrence)

### IV. RESULT AND DISCUSSIONS

In his work, [16] pointed out that analyzing the demographic data of respondents can give confidence that responses are reliable and representative of what is obtainable in the field (project environments). Table I and Table II show that the respondents are all professionals with high level of training and experience. All the respondents have at least a degree from a higher institution, with 52.08% of respondents having M.Sc. and 6.25% having PhD. Experience levels indicate that all the respondents have above 5 years of experience; 10.42% have experience of 6 – 10 years, 29.17% have 11 – 15 years, 33.33% have 16 – 20 years, while 27.08% have more than 20 years of experience.

Table III categorizes the 28 identified interfaces management issues into five groups according to the five project management process groups as follows; interfaces during initiation phase, interfaces during planning phase,

interfaces during execution phase, interfaces during monitoring and control phase and interfaces during closing phase.

TABLE I  
EDUCATION LEVEL OF RESPONDENTS

Qualification	O' Level	HND/Bachelors	M.Sc.	PhD
No of respondents (percentage)	0 (0%)	20 (41.67%)	25 (52.08%)	3 (6.25%)

TABLE II  
EXPERIENCE LEVEL OF RESPONDENTS

Years of Experience	< 5 yrs	6 – 10 yrs	11 – 15 yrs	16 – 20 yrs	> 20 yrs
No of respondents (percentage)	0(0%)	5(10.42%)	14(29.17%)	16(33.33%)	13(27.08%)

TABLE III  
SUMMARY OF RESPONDENTS' RATING OF IDENTIFIED PROJECT INTERFACES MANAGEMENT ISSUES

Key	Description of Interface Management Issue
Interfaces during Initiation Phase	
I <sub>1</sub>	Wrongful interpretation of stakeholders' requirements
I <sub>2</sub>	Project Manager and stakeholders interface issues manifested in a failure to incorporate certain stakeholders' requirement in the project scope
I <sub>3</sub>	Project and Project manager interface issues manifested by selection of an incompetent project manager
I <sub>4</sub>	The project and preliminary studies interfaces issues manifested in errors in feasibility studies or project charters
Interfaces during Planning phase	
P <sub>1</sub>	Project managers and planning data interface issues manifested in inadequate data collection for project estimate
P <sub>2</sub>	Project and the Project manager interface issues manifested in biased and overly optimistic projections
P <sub>3</sub>	Design clashes caused by wrong sequencing of task
P <sub>4</sub>	Designs to be synchronized are not interoperable
P <sub>5</sub>	Project contractors and client interface issues relating to disputes over contractual terms
P <sub>6</sub>	Interfaces issues manifested in errors made in creating functional specifications
Interfaces during Execution phase	
E <sub>1</sub>	Unethical conducts sometimes displayed by workers in order to achieve high profits (e.g. using inferior material mix)
E <sub>2</sub>	Project and Project Supervisor interface issues manifested by poor supervision of works and its attendant consequences
E <sub>3</sub>	Project and project workers interface issues manifested when incompetent workers make mistakes during execution
E <sub>4</sub>	Project workers' interface issues manifested when workers forget to relay important information
E <sub>5</sub>	Project workers' interface issues manifested when workers forget to act on important relayed information
E <sub>6</sub>	Wrongful interpretation of drawings and designs
E <sub>7</sub>	Project and suppliers issues leading to late receipts of supplies and/ or materials
E <sub>8</sub>	Superior and workers interface issues sometimes manifested in misinterpretations of directives
E <sub>9</sub>	Project functional units interface issues manifested in a lack of harmony between the different units, and a lack of synchronization of their deliverables
E <sub>10</sub>	Poor information flow between units and other organizations related to the project (e.g. purchase orders placed but not received)
Interfaces during Monitoring and Control	
M <sub>1</sub>	Project and regulatory agency interface issues manifested in suspension of whole or part of work by regulatory agencies
M <sub>2</sub>	Project and the host community interface issues that could manifest in strained relations when the project has detrimental impact on the community
M <sub>3</sub>	Workers and Inspectors interface issues manifested when workers put up false show to trick inspectors
M <sub>4</sub>	Failure to act on recommendations of monitoring or safety offices
M <sub>5</sub>	Interface between monitoring devices (information) and project, manifested in the use of inappropriate devices or data in taking measurements
Interfaces during project closing phase	
C <sub>1</sub>	The project and lessons learned documentation interface issues manifested in not producing or wrongly documenting the lessons learned
C <sub>2</sub>	The project and vendors interface issues manifested in disagreements when finalizing outstanding contracts
C <sub>3</sub>	The project and client interface issues manifested in challenges met when transferring responsibility

Table IV below reveal that within the Initiation category, I<sub>3</sub> (the project and the project manager interface issues manifested by selection of an incompetent project manager) is the most significant (ranked first) with a matrix score of 1342. This could be because the project

manager has overall responsibility of the project; he makes critical decisions regarding resource allocation, and coordinates the various activities and individuals involved in the project. The selection of an incompetent project manager can only mean chaos to the project. With a matrix

score of 1218, the second ranked interface in the initiation category is I<sub>2</sub> (Project Manager and stakeholder interface issues manifested in a failure to incorporate certain stakeholders' requirement in the project scope). This means that the project manager should pay particular attention to stakeholders' management. Within the Planning category, P<sub>5</sub> (Project contractors and client interface issues relating to disputes over contractual terms) is the highest ranking interface with a matrix score of 608. This underscores the impacts that contractual disputes can have on the project. The interoperability of designs (P<sub>4</sub>) is the next significant interface within this group with a score of 546. Within the execution category, the most significant interface is E<sub>1</sub> (the project and project workers interface) with a score of 2924. This interface is very significant because, it is the workers that complete project works, and any unethical or unprofessional conduct on their part will adversely affect the project. The recent Nigerian episodes of building collapse can be traced to this interface; because in most of the investigated cases, project works were completed with inferior materials and mixes, probably in a bid by the workers to make dishonest gains [17]. With a score of 1600, E<sub>2</sub> (Project and Project Supervisor interface issues manifested by poor supervision of works and its attendant

consequences) is the next most significant interface in the category. This adds up because proper supervision helps check the unethical and unprofessional conduct that is sometimes displayed by workers. The least significant interface in this category is E<sub>7</sub> (the Project and Suppliers interface). The high matrix scores of the interfaces in the monitoring category relates to their significance. The highest ranked (with a score of 1416) is M<sub>4</sub> (Project and Safety/Monitoring office Interfaces problem manifested in failure to act on recommendations of monitoring or safety offices). This highlights the importance of religiously heeding the recommendations of safety and/ or monitoring offices. Closely following M<sub>4</sub> is M<sub>5</sub> (Interface between monitoring devices/information and the project manifested in the use of inappropriate devices or data in taking measurements) and M<sub>3</sub> (Workers and Inspectors interface issues manifested when workers put up false show to trick inspectors) in second and third places respectively. Within the Closure category, C<sub>1</sub> (project and lessons learned documentation interface) is the lowest ranking and thus least significant interface. This can be explained in that, such documentation will usually affect not the current project but future projects.

TABLE IV  
SUMMARY OF RESPONDENTS' RATING OF IDENTIFIED PROJECT INTERFACES MANAGEMENT ISSUES

Keys	Probability	Impact	Matrix Score	Ranking within each category	Overall Ranking
I <sub>1</sub>	19	52	988	3	10
I <sub>2</sub>	21	58	1218	2	8
I <sub>3</sub>	61	22	1342	1	4
I <sub>4</sub>	28	14	392	4	20
P <sub>1</sub>	15	12	180	5	26
P <sub>2</sub>	13	9	117	6	28
P <sub>3</sub>	16	18	288	4	24
P <sub>4</sub>	14	39	546	2	16
P <sub>5</sub>	19	32	608	1	15
P <sub>6</sub>	26	14	364	3	22
E <sub>1</sub>	43	68	2924	1	1
E <sub>2</sub>	32	50	1600	2	2
E <sub>3</sub>	59	22	1298	4	6
E <sub>4</sub>	44	14	616	7	14
E <sub>5</sub>	25	19	475	9	18
E <sub>6</sub>	11	48	528	8	17
E <sub>7</sub>	41	10	410	10	19
E <sub>8</sub>	56	15	840	5	11
E <sub>9</sub>	16	49	784	6	12
E <sub>10</sub>	60	22	1320	3	5
M <sub>1</sub>	33	21	693	4	13
M <sub>2</sub>	16	23	368	5	21
M <sub>3</sub>	15	71	1065	3	9
M <sub>4</sub>	59	24	1416	1	3
M <sub>5</sub>	34	38	1292	2	7
C <sub>1</sub>	18	10	180	3	26
C <sub>2</sub>	20	15	300	1	23
C <sub>3</sub>	23	9	207	2	25

The general ranking of the 28 identified interfaces issues (last column of Table IV above) reveals that the most significant project interfaces ranked 1st, 2nd and 3rd are E<sub>1</sub>, (the project and project workers interface) E<sub>2</sub> (Project and Project Supervisor interface issues manifested by poor supervision of works) and M<sub>4</sub> (Project and

monitoring office interface issues manifested in a failure to act on recommendations) respectively, while the least significant, ranked 28th, is P<sub>2</sub> (Project and the Project manager interface issues manifested in biased and overly optimistic projections).

TABLE V  
RANKING OF THE INTERFACES BY CATEGORY

Interfaces Category	Probability	Impact	Matrix score	Rank
I	32.25	36.50	1177.13	2
P	17.17	20.67	354.90	4
E	38.70	31.70	1226.79	1
M	31.40	35.40	1111.56	3
C	20.33	11.33	230.34	5

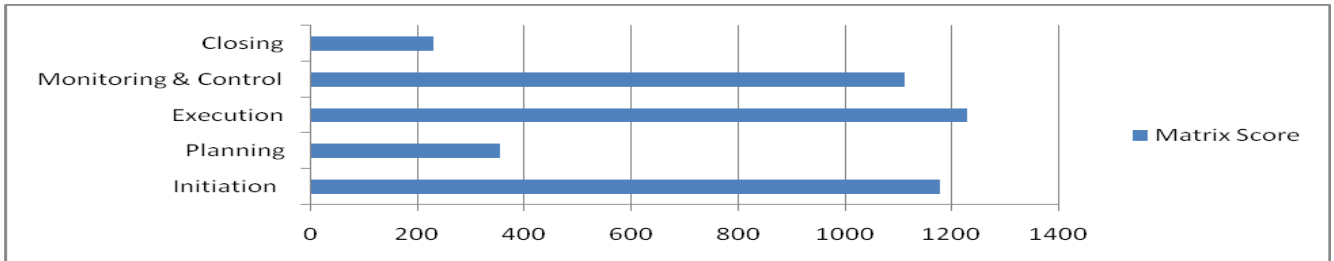


FIGURE I  
SIGNIFICANCE OF DIFFERENT INTERFACES CATEGORIES

It can be observed from Table V and Figure I that the interface category ranked first is the interfaces during project execution phase with a matrix score of 1226.79. This underscores the need to carefully coordinate and supervise all execution activities. The second interface category in the ranking is interfaces in the project Initiation phase with a matrix score of 1177.13. This implies that project conceptualization and associated activities such as capturing stakeholders’ requirements, selection of project manager, project charting etc are critical for overall project performance; and any interfaces management failure during this phase can adversely undermine the achievement of project goals. Interfaces during Monitoring and Control are also shown to be potentially highly impacting and ranked third with a matrix score of 1111.56. Adequate and standardized control gates should be established and made operational. The fourth ranked interface category is interfaces during planning. That project interfaces in the planning phase have significant impact (as evidenced by its matrix score of 354.90) is consistent with the assertion of [18] that besides political reasons, a major reason for poor performance and frequent failure of projects is that most government projects are known to be poorly planned or lack planning at all, before execution. With an average matrix score of 230.34, the closing phase is the lowest ranking of the five interfaces categories. This summary means that the project manager should pay particular attention to the interfaces encountered in the execution phase of a project, followed by those in the initiation phase, and monitoring phase, and the least attention should go to interfaces in the closing category.

V. CONCLUSIONS

Prioritizing identified project interfaces in terms of potential impacts is an effective approach for managing project interfaces because it directs management efforts to the interfaces with the highest potential impacts. On the basis of the results of this study, it can be concluded that “*project-workers interfaces problem manifested in use of*

*inappropriate mixes*” is the highest impacting project interface problem; while “*project-supervisor interface problem manifested in poor supervision of works*” and “*Project-monitoring office interface problems manifested in failure to act on recommendations of safety/monitoring office*” follow in second and third respectively.

Also, it is concluded that the execution phase of a project is the most important phase in a project lifecycle in terms of potential impacts (that is, it is the phase that could result in the highest losses to the project). In this regard, the other phases in a project life cycle in decreasing order of importance are: Initiation phase; Monitoring and Control; Planning phase; and Closing phase.

This research study will contribute to reducing the rate of failure of construction projects. By identifying the interfaces that significantly affect project success; support is provided for management in developing strategies to address the problem of failure of construction projects. From the results of this study, it is recommended that to achieve project success and sustainability of construction works, management should employ strategies that would: (1) check use of inappropriate mixes, and (2) ensure compliance of intermediate project deliverables with relevant standards.

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