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WORK BREAKDOWN STRUCTURE: DOES IT MATTER FOR PROJECT CONTROL INTEGRATION AND PROJECT INTERFACE MANAGEMENT OF NIGERIAN CONSTRUCTION FIRMS?

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Abstract
This study investigated whether work breakdown structure matters for project control integration and interface management of selected construction companies publicly listed on the Nigerian Exchange Group. The Survey research design and two (2) variables capable of being influenced by work breakdown structure – project control integration and interface management were employed. A sample of two hundred and forty-three (243) employees of publicly listed construction firms was drawn and the data obtained were analyzed using descriptive and inferential statistical techniques. Results obtained indicated that work breakdown structure significantly influences project control integration (t-value = 6.82; Prob. = 0.000 < 0.05) and interface management (t-value = 5.99; Prob. = 0.000 <0.05) with a positive relationship. The conclusion is that work breakdown structure matters for project control integration and interface management of construction firms in Nigeria. Findings underscored the imperativeness of work breakdown structure in optimizing project control integration and interface management. Thus, firms in the construction industry should focus on encouraging the use of work breakdown structure by dividing intricate projects into simpler, smaller and manageable tasks to improve the overall project performance. This study assessed how dividing complex projects into smaller, simpler and manageable tasks can improve project control and interface management of publicly listed construction companies in Nigeria.

Key Words: *Interface Management; Project Control Integration; Project Management; Work Breakdown Structure.*

Introduction
The production process rationalization has drastically transformed the construction industry in recent years. Accordingly, the Lean Construction Theory (LCT) which is hinged on varied concepts (for example, communication, transparency and project control, interface management, etc.) that improve the soundness of project management is of vital significance in the construction industry (Zuidema, 2022). Vania, Yusuf and Leni (2018) argued that Work Breakdown Structure (WBS) is yet another method that can aid Project Control Integration (PCI) and Interface Management (INTM). Jebrin (2018) sees WBS as a way of decomposing projects into smaller and simpler elements to better control and manage the project contents. The axiom of this study is that the usage

of WBS can improve PCI and INTM in complex construction project works. First, interfaces are predominantly of four (4) variants - technical, time, organizational and geographical interfaces. Polonski (2015) stated that interfaces in construction projects can be adequately managed when the project team has the avenues to communicate the distinct elements of the project and as well be able to visualize project requirements and activities in a timely dimension. The use of WBS in enhancing INTM leads construction projects to timely process the value chain of the products from one activity to another devoid of constraint; a condition the LCT has argued that with WBS, projects become faster and less costly. Second, PCI is vital as it is needed for efficient interface management. Even when the right firm is set up, time interface management may not be adequately performed without project control. Hence, Adagba, Hassan and Umar (2023) contended that management of the interface between two successive phases is essential in guaranteeing integration of the overall projects along with project implementation. However, PCI and INTM can undoubtedly be successfully done via WBS (Devi, R. & Reddy 2012; Albert, 2014). Regardless of the imperativeness of WBS in the construction and manufacturing industries, there are limited empirical studies on whether WBS influences PCI and INTM of publicly listed construction companies in Nigeria.

Given the above, this study:

1. assessed the extent that Work Breakdown Structure (WBS) affects the Project Control Integration (PCI) of the selected construction firms in Nigeria.
2. investigated the effect of Work Breakdown Structure (WBS) on Interface Management (INTM) of the selected construction firms in Nigeria.

As a result, the following hypotheses in its null form were formulated for further testing and analyses:

H_o: Work Breakdown Structure (WBS) has no significant effect on the Project Control Integration (PCI) of the selected construction firms in Nigeria.

H_o: Work Breakdown Structure (WBS) does not significantly affects the Interface Management

Literature Review

Work Breakdown Structure (WBS)

Numerous definitions of work breakdown structure (WBS) abound in the literature; the cumbersomeness in the definition of WBS however can only be made burdenless if the distinguished varied concepts of researchers are comprehensively explained. Nevertheless, the most generally accepted views of WBS are those given by Tiner (1985) cited in Zuidema (2022) where it is been envisaged as a technique of defining and organizing work such that project performance can be efficiently and optimally measured and controlled. Similarly, Ayas (1997) cited in Adagba, et al (2023) sees a hierarchy of needed works/tasks to be carried out to complete a project. Mhetre, Konnur and Amarsinh (2016) observed that project management is the decomposition of work activities into simpler and smaller segments.

According to Amer, Hui and Golparvar-Fard (2021), WBS is a method of splitting projects into components, fragments and successive smaller sub-divisions. Prior

researchers (Al-Anbari & Khalina, 2013; Wang, Wei & Jian 2020; Alameri, et al 2021) assert that WBS is an embodiment of a tree-like representation of a project in terms of its technical framework of how each component of the project can be achieved. Hence WBS is described as the industrial, physical and sequence of activities required procedurally to complete a project in the most efficient means. This study contributes to filling a gap in WBS, PCI and INTM, and generalizes the use of WBS in improving PCI and INTM of construction firms in Nigeria.

Project Control Integration (PCI)

Project control is a vital aspect of project management. The reason for the importance of PCI in project management is that a project can require its distinctive management. Hence, a wrong decision may occur and result in cost overrun when sketchy project designs do not get strong support with detailed design integrating all elements of a project (Nana-Addy, Musonda & Okoro, 2022). Thus, project failure, delays or abandonment can be averted if sufficient project control integration tools are set up on both costs and planning (Naeema & Akbarb, 2021; Uju & Uzonwanne, 2017).

PCI is not only necessary for time-interface in project management, it often relates to the harmonization of conflicting needs for resources/personnel or conflicting priorities for the use of facilities/ equipment (Moya-Colorado, León-Bolaños & Yagüe-Blanco, 2021). PCI needs to be well coordinated with project organization/procedures to achieve its objective. Morris (1983) cited in Fariala and Awolusi (2021) highlights that research has revealed that PCI can be improved upon via the use of WBS. The researchers further argued that contemporary construction and manufacturing firms' use of WBS helps the project management team's capability to control and integrate all phases required to ensure the timely completion of a project.

Project Interface Management (INTM)

Project Interfaces are an imperative part and must be considered if a project is to be successful (Egwim, et al, 2021; Aiminhiefe, 2022). According to Breesam and Jawad (2021), INTM gives a project its added value and offers great leverage in project architecting. The inability of construction companies to leverage INTM is considered a common failure point of a project; thus, INTM is often seen as a cumbersome project element to manage. Management of project interfaces appears as a vital activity demanding focused attention from the project team (Adindu, et al, 2020). The beginning of INTM followed the prior development of the system perspective (Morris, 1983) cited in Abdulkadir, et al, 2020).

INTM consists of partitioning projects into sub-systems, by identifying interfaces requiring specific management concentration and indicating ways for managing the sub-systems of the project. Hence, Healy (1997) cited in Abdulhaqq, et al (2022), sees INTM as the management of interdependencies and tasks across the boundaries of a project interface. More practically, for Zwikael, Chih and Meredith (2018), INTM is part of project integration because it ensures that all essentials of a project (such as responsibilities/tasks, subsystems, organizational units and people) fit collectively as an incorporated whole, which functions according to a project plan. Consequently, INTM

consists of identifying, documenting, scheduling, communicating and monitoring interfaces linked or related to a project (Damoah, Ayakwa & Kumi, 2021; Albtoush, Doh & Rahman, 2021).

Arising from the foregoing, it can be broadly explained that WBS is a vial tool enabling PCI and INTM. Once the work breakdown structure is considered sufficiently detailed and organized rightly, it can serve as a project management tool aimed at improving PCI, INTM and the overall performance of a project. The dividing of complex projects into simpler, smaller and manageable tasks is vital for the overall project performance. Because of the above, the conceptualized relationship between WBS, PCI and INTM is shown in Figure 1:

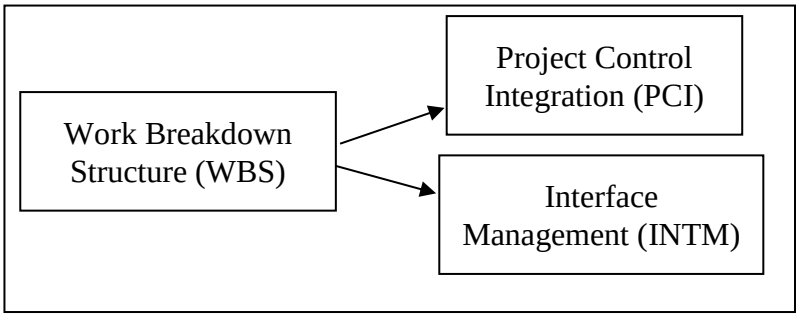


Figure 1: Conceptual Model of Study
Source: Conceptualized by the Researcher (2024)

Materials and Methods

The study employed a survey design to assess whether Work Breakdown Structure (WBS) influences Project Control Integration (PCI) and Interface Management (INTM) of selected construction companies publicly listed on the Nigerian Exchange Group (NGX). The population of the study comprised 620 construction companies' employees out of which two hundred and forty (243) were sampled; the sample was obtained via the Taro-Yamane sample-size formula. The questionnaire was administered to onsite and off-site employees of the selected construction firms on a face-to-face basis.

The questionnaire was designed using a reversed 4-point Likert scale. Cronbach alpha was used in determining the internal consistency of the questionnaire and reliability coefficients of 0.88 (WBS), 0.86 (PCI) and 0.79 (INTM) respectively were obtained. Data obtained were analyzed via descriptive and inferential statistical tools. The dependent variables comprised PCI and INTM while the independent variable was WBS; hence, simple regression models were estimated as follows:

$PCI = f(WBS)$ - eq. 1
$INTM = f(WBS)$ - eq. 2

Equations 1-2 were re-estimated to show their explicit forms as follows:

$PCIF_{it} = ß_0 + \delta_1 WBS_{it} + \varepsilon_{it}$ - eq. 3
$INTM_{it} = ß_0 + \delta_1 WBS_{it} + \varepsilon_{it}$ - eq. 5

Where: WBS = Work Breakdown Structure; PCI = Project Control Integration; INTM = Interface Management; δ_1 = Regression Coefficient; ε = Error Term; t = Time Element; i = Individual Research Subjects; the statistical analysis was carried out via STATA 16.0.

Results and Discussion

Table 1: Summary Descriptive Results

Variables	Mean Score	Standard Deviation Score	Minimum Score	Maximum Score
WBS	2.6122	0.0340	1	4
PCI	2.5179	0.0216	1	4
INTM	2.6003.	0.0362	1	4

Source: Computed by the Researcher (2024)

The summary of the descriptive results (see Table 1) indicates that WBS, PCI and INTM scored 2.5 above the cut-off point of mean scores; this implies that items on WBS, PCI and INTM are suitable metrics for assessing the relationship between WBS and PCI and INTM individually of construction firms in Nigeria. The result is further supported by the low standard deviation scores; hence, to an extent, WBS is predominantly practised among the selected publicly listed construction firms in Nigeria.

Table 2: Karl Pearson Correlation

Variables	PCI	INTM	WOBS
PCI	1.0000		
INTM	0.0289	1.0000	
WBS	0.1099	0.1045	1.0000

Source: Computed by the Researcher (2024)

The Karl Pearson correlation coefficients (see Table 2) indicate a positive relationship between WBS PCI and INTM; impliedly, there is a positive relationship between Work Breakdown Structure, Project Control Integration and Interface Management of the construction firms in Nigeria.

Table 3: Regression Results for WBS and PCI

Estimators	Predictors	Parameters
R-Squared	0.8225	t-value = 6.82
Adjusted R-Squared	0.7213	t-Prob. = 0.000
F-Ratio	13.324	
Probability. F	0.000	

Source: Computed by the Researcher (2024)

The regression results for WBS and PCI (see Table 3) revealed that R^2 is 0.8275; indicating that WBS explain about 83% of the systematic variation in PCI of the selected construction firms in Nigeria. Hence, the model of WBS and PCI offers a good fit to the datasets. F-ratio is 13.324 and it signifies that WBS significantly influence PCI. Also, the t-value shows that WBS significantly and positively affects the PCI of the selected construction firms in Nigeria. This finding corroborates the viewpoints of Jebrin (2018);

and Zuidema (2022) who revealed that work breakdown structure significantly and positively influences project control integration.

Table 4: Regression Results for WBS and INTM

Estimators	**Predictors**	**Parameters**
R-Squared	0.8688	t-value = 5.99
Adjusted R-Squared	0.7574	t-Prob. = 0.000
F-Ratio	13.986	
Probability. F	0.000	

Source: Computed by the Researcher (2024)

The regression results for WBS and INTM (see Table 4) established that R^2 is 0.8688; indicating that WBS explain about 87% of the systematic variation in INTM of the selected construction firms in Nigeria. Thus, the model of WBS and INTM offers a good fit to the dataset. F-ratio is 13.986 which implies that WBS significantly affect INTM. In addition, the t-value showed that WBS significantly and positively affects the INTM of the selected construction firms in Nigeria. This finding agrees with the results of Jebrin (2018); and Zuidema (2022) who showed that work breakdown structure significantly and positively affects interface management.

Conclusion and Recommendations

In light of the empirical results, it can be said that publicly listed construction firms have a very high degree of awareness about work breakdown structure (WBS); this awareness is conceivably reflected in the descriptive results and comparison, with prior studies. WBS have numerous advantages such as simplifying project execution, accurate assignment of tasks to project team, improving project milestones/control points, aiding cost estimation, time and risk management associated with a project and the determinization of project scope. Hence, an understanding of WBS is imperative for the construction industry.

Furthermore, based on the inferential results, it was revealed that a significant positive relationship exists between WBS, Project Control Integration (PCI) and Interface Management (INTM) of publicly listed construction firms in Nigeria. Based on the results, the study recommends that the construction industry should focus on promoting the usage of WBS by segmenting cumbersome projects into simpler, smaller and manageable tasks to improve project control integration, interface management and overall project performance

The Findings underscored the imperativeness of WBS in optimizing the PCI and INTM of construction firms. Consequent to the above, publicly listed construction firms should take WBS as an essential step in project management. This study contributes to knowledge by filling a gap in the literature on what is known about WBS, PCI and INTM while at the same time establishing that WBS matters for PCI and INTM of construction firms in Nigeria.

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