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Research Article

Nature of Communication Ineffectiveness Inherent in the Procurement Systems on Mass Housing Projects

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Mass housing projects (MHPs) are deemed to exhibit unique procurement systems which consequently induce communication ineffectiveness that continues to dominate the challenges among mass housing project teams. However, this acknowledged communication ineffectiveness inherent in the unique procurement system features of mass housing project among the project team remains to be empirically examined. This study seeks to investigate the influence of procurement system (PS) features of MHPs to communication ineffectiveness among the mass housing project team. By adopting a quantitative method design, a structured questionnaire survey on project team leaders managing MHPs in Ghana was used in collecting empirical data. Structural equation modeling (SEM) was used to explore the communication problems inherent in the PS features of mass housing projects. The results revealed moderate to high effects of communication ineffectiveness in information flow and information composition inherent in the unique PS features of MHPs. The results further revealed misunderstanding, inaccuracies, barriers, and information dissemination challenges as the major communication ineffectiveness induced by the PS features of MHPs. By gaining knowledge and understanding into the communication ineffectiveness associated with these features of MHPs, practitioners are well positioned to plan communication and management strategies to engender success in mass housing delivery.

1. Introduction

Communication ineffectiveness among mass housing project teams continues to be emphasized as one of the dominant challenges that are inherent in the unique nature and attributes of mass housing projects that consequently contribute to related inefficiencies and failures on mass housing projects (MHPs) [1–3]. Indeed, Adinyira et al. [4] and Ahadzie et al. [5] revealed that MHPs possess unique, physical, organizational, and operational features. However, what is less known is the nature and extent these unique features of MHPs influence the communication outcome among the project team. Adinyira et al. [4] further revealed that mass housing projects possess unique complex network of procurement systems which underline their organizational attributes. Additionally, Ogunsanmi [6] revealed that MHPs exhibit unique procurement attributes that have significant implication for its subcontracting, labour management, and relational communication performance compared to tradition building projects often encountered in the construction industry.

According to Eriksson and Pesämaa [7], the procurement structure and contracting arrangements define the team roles and line of communication that significantly influence the performance outcome of construction projects. Additionally, Enshassi and Burgess [8] previously indicated that efficiency of the supervision and team performance is challenged by the procurement structure and contracting adopted on the construction projects. By drawing on the theoretical and practical perspective of mass housing delivery in Ghana and composition of the project team, it can be emphasized that indeed procurement structures and subcontracting systems adopted on mass housing project offer inherent challenges in the management and communication performance on MHPs that consequently result in loss in productive time in the delivery compared to traditional construction projects [3].

Here communication performance or effectiveness is defined as the evaluation of the communication task performed in achieving conformance outcome and mutual understanding among the communication interactants (sender and receiver) [9–12].

Consequent to the above, mass housing approach to housing supply has indeed been adopted and pursued as a dominant and veritable approach by many developed and developing countries to effectively ensure success in housing delivery [13]. Against this background, ensuring communication effectiveness which is essential to enhancing managerial efficiencies is crucial to the project management practice on MHPs towards success. This assertion is underpinned by the fact that effective communication plays a critical role in team effectiveness, integration, and performance that are crucial factors in engendering project delivery success [9, 10, 12]. Indeed, Ibem et al. [1] established that poor communication is among the critical factors impeding success in public housing provision in Nigeria and other notable developing countries in sub-Saharan Africa. This assertion had already been noted by Enshassi [3] and Enshassi and Burgess [8].

However, even though studies on mass housing communication performance in recent times have acknowledged that communication ineffectiveness inherent in the unique features of MHPs is rife, significant among the features is the effect of the procurement systems adopted (see [2, 14, 15]). Interestingly, in spite of this assertion and admission of the communication ineffectiveness inherent in the procurement features of MHPs, this has remained an assertion lacking a more rigorous empirical assessment of the nature and extent of these communication challenges from the procurement features. This study therefore aims at assessing the extent and the nature of the contribution of the procurement features of MHPs to communication performance among the project team. The following sections of this paper present a review of the procurement system features of mass housing and project team communication performance. This is followed by the research methodology and analytical approach adopted for the study. The findings emerging from the data analysis are subsequently presented and discussed followed by the implications of the findings and conclusion.

2. Mass Housing Projects and Their Attributes

The term mass housing project has dominantly been defined as term purely focusing on the large scale production of housing development projects (see [16–18, 28]). However, these definitions fail to account for the unique attributes exhibited by mass housing projects. Here in this study, the term has been defined as follows:

> the design, construction, and management of standardized single or multiple domestic house units usually in the same or multiple sites and geographical locations executed within the same project scheme and under the same management and contract for either speculative or user-defined delivery [29].

According to Ahadzie et al. [4, 14], Zairul and Rahinah [2], and Enshassi [3], mass housing projects exhibit unique features which are seen in their project environment, contractual arrangement, physical, organizational, and operational attributes, design, procurement, construction, and management intuition compared to other project typologies. The definition above seems to encapsulate these unique attributes of MHPs and thus seems appropriately adopted for this study. Studies on mass housing attributes have indicated that MHPs exhibit unique procurement arrangements which underline the organizational attributes that make the management of MHPs require unique skills and management style [2, 14]. The organizational features of MHPs are evidenced in its complex network of team relationship, multiple interdependent subcontracting under scheme, and complex network of procurement systems [4, 6, 15]. In the context of this study, the organizational task functions that characterize the procurement management attributes of MHPs are defined by the contract packaging, management concept for labour contracting and trade subcontracting, and coordination concept in subcontracting arrangement [2, 6, 15, 18].

In a mass housing project environment, there is an obvious interplay of interdependent, collaborative, and multidisciplinary team participants. Hence, these attributes of MHPs make understanding and adapting the communication actions, management, concept, and skills to these procurement characteristics and organizational context more crucial towards effective communication among the team.

2.1. Nature of Procurement Systems (PS) Features on Mass Housing Project. Procurement systems (PS) on construction projects are considered very crucial in the successful delivery of the project [30]. Procurement system refers to the appropriate overall delivery system on construction projects including the contract system for each of the contract or work packages involved as components of the chosen delivery system and the management concept to suit the delivery system and contract system(s) selected [31]. According to Hide et al. [32], procurement method and style adopted on construction projects specify the contractual arrangements and the responsibilities within a single or multiple project teams that may enhance or impede communication. It is also postulated that procurement arrangements is more likely to promote team integration that significantly enhances collaboration among the team towards effective management [33, 34]. Mass housing projects adopt varied unique procurement approaches in the selection of contractors, materials, and consulting teams. From a practical perspective, mass housing consulting teams may take the form of either a team composition where all members are from outside the developing organization or all from the organization and a mix of part from the organization and part from outside the organization. The procurement systems in contractor selection and subcontracting may also take the forms of Labour-Only and Direct-Labour and other discretionary procurements such as Alliancing, Partnering, Joint Ventures, and single or multilayered subcontracting [6, 19, 20]. These procurement styles come with their challenges in management and communication performance on the mass housing projects. The subcontracting arrangements are often

Table 1: Mass housing project procurement system features conceptual variables.

Description of variables in the procurement system features (NPS) factor	
PS1	Labour contracting style on housing units under scheme
PS2	Project team composition adopted on the housing scheme under management (e.g., only in-house team or in-house and external professionals (mixed))
PS3	Construction material procurement style adopted on the housing scheme
PS4	Subcontracting style adopted across housing units under scheme
PS5	Control, monitoring, and coordination style in subcontracting on housing units under housing scheme
PS6	Prospective buyer involvement in the construction process under scheme

Source. See [2, 6, 14–21].

Table 2: Mass housing project team communication effectiveness measures.

Description of variables in the project team communication performance (PCE) factor (information flow)	
PCE3	Receiving less information than expected from team participants for tasks
PCE7	Late delivery of needed communicated information
PCE10	Receiving more information than necessary for the tasks
PCE12	Withholding of part of the information by the one who controls communication
PCE13	Difficulty in disseminating information among project team
PCE14	Difficulty in accessing communicated information from channels
PCE15	Withholding of whole of the information by the one who controls communication
Description of variables in the project team communication performance (PCE) factor (information composition)	
PCE1	Persistent change in content of communicated information
PCE2	Lack of consistency in communicated information leading to lack of coordination among project team
PCE4	Persistent change in meaning of communicated information
PCE5	Receiving conflicting information from team participants
PCE6	Lack of clarity in communicated information resulting in different interpretations
PCE8	Misunderstanding of communicated information
PCE9	Lack of conciseness in communicated information among the project team
PCE11	Lack of coherency in communicated information resulting in different interpretations
PCE16	Lack of defined roles and responsibilities among members of the team leading to communication failure

Source. See [9, 10, 12, 22–27].

integrated into construction projects and are significantly useful for organizational analysis that enables the management task to be deconstructed into its elemental parts [35]. This according to Hughes and Murdoch [35] enables effective organizational structures to be developed and adapted to suit the project environment. The contracting arrangements on mass housing projects define the various packaging, subcontracting arrangement, and labour management concepts adopted in the delivery of the housing units being managed by the project team. Mass housing developments adopt various subcontracting approaches that extend across various elements such as labour and trades. This is considered as very useful and brings clarity to the description of roles and responsibilities on construction projects [35].

Here in this study, six (6) variables composing the unique PS features were identified and derived from the extant literature and this is summarized in Table 1.

2.2. Mass Housing Project Team Communication Effectiveness Measures. Varied approaches have been adopted in the assessment of communication performance on construction projects. However, critical assessment of notable studies on the subject in the construction industry has dominantly adopted the CII [12] approach to communication performance measures. The CII [12] is based on comprehensive 9-variable list of key indicators. These variables have extensively been used by Xie [22], Xie et al. [23], Murray [24], Mead [25], and Thomas et al. [26] to assess the contribution of management concepts, team relations, communication problems, effects of technology adoption, and procurement systems, respectively, on construction projects. Hence, in ensuring triangulation and theoretical validity in the measure, this was also adopted for this study. These indicators relate to the accuracy, completeness, understanding, gatekeeping, timeliness, barriers, and procedures of the communication outcome on the construction project [12].

Here in this study, the assessment of the project team communication effectiveness was measured by operationalized sixteen (16) variables based on the CII [12] (see Table 2). By adopting the team communication effectiveness indicators

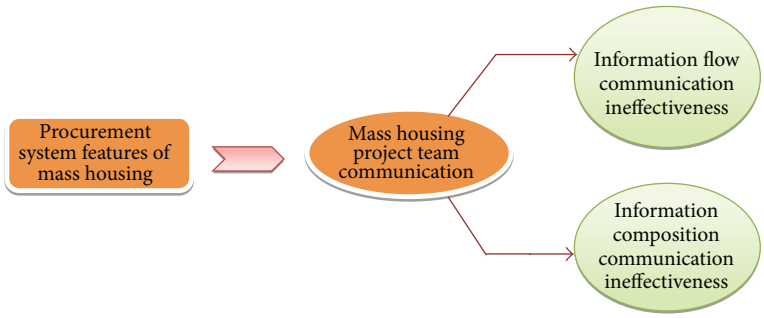

Figure 1: Conceptual model for the influence of procurement features of mass housing project on team communication effectiveness.

by the CII [12], the induced communication ineffectiveness inherent in the procurement system features of MHPs experienced among the project team was perceived in the flow and composition of the project related information. Hence, drawing on the theoretical perspective of the study, the analysis of the communication effectiveness among the mass housing project team was conceived in two main dimensions as in the flow of the information and the composition of the information. Consequently, the project team communication associated with the flow of information factor was defined by seven (7) indicator variables while that associated with the composition of the information factor was defined by nine (9) variables and these are summarized in Table 2.

Given the lack of knowledge of empirical evidence of the perceived communication ineffectiveness inherent in the procurement system attributes of MHPs, it was important to take this perception a step further through an empirical assessment. Synthesizing all the perceptions and assertions on the perceived influence of the procurement features on MHPs team's communication performance (see [2, 6, 14, 15]), it can generally be conceptualized that the extent and nature of the potential influence of the procurement features on the communication effectiveness among the team are an aggregate effect in both information flow and information composition in the communication tasks performed. The uniqueness of this is that previous studies have not evaluated communication outcome in these two dimensions (see [22, 23, 25–27]). By this approach, the conceptualization coherently and unambiguously unifies and aggregates nature and extent of the inherent communication ineffectiveness, offering a broader and microscopic assessment of the communication outcome. Hence the conceptual model portraying the perceived interrelationships among the key variables operationalized with information flow (7 variables), information composition (9 variables) as the endogenous (dependent) factor, and unique PS features on mass housing projects (6 variables) as the exogenous (independent) factor is represented in Figure 1.

Further to the verification of the nature and extent of the perceived influence of the procurement features of MHPs on communication performance among the team, two main hypotheses were postulated for testing. From the perspective of the assertions in extant literature that the communication effectiveness on MHPs is largely inherent from its unique attributes and project environment, the following hypotheses are expected.

Hypothesis 1 (H1). The MHPs communication ineffectiveness experienced among the project team in relation to information flow will be significantly influenced by the procurement features.

Hypothesis 2 (H2). The MHPs communication ineffectiveness experienced among the project team in relation to information composition will be significantly influenced by the procurement features.

3. Methodological Approach

This study mainly adopted a quantitative approach due to the fact that it is well noted for its appropriateness for testing prior formulations [36, 37]. Additionally, studies on construction communication performance measures have often and dominantly adopted the positivist stance with quantitative design using statistical analysis to explore causal relationship among variables as ideal to yield favourable and acceptable objective results (see [22, 23, 25–27]). Hence adopting the quantitative approach further ensures triangulation and theoretical validity. From the hypotheses and the intended structural equation modeling approach as the analytical method for the study, a structured questionnaire survey was adopted to collect empirical data by administering the questionnaire on project team leaders on mass housing construction project sites of active real estate organizations belonging to the Ghana Real Estate Development Organization, an umbrella body for real estate housing in Ghana. The variables contained in the questionnaire were on the procurement systems features adopted on MHPs and the communication ineffectiveness experienced among the project team. These were measured using a Likert-type five-point scale similar to that used in similar studies (cf. [22, 23, 27]).

The project team leaders were to draw on their practical experience, knowledge, and involvement in mass housing development to first assess the frequency of the information flow and composition related communication ineffectiveness experienced among the team inherent in the PS features of MHPs on a five-point Likert scale interpreted as very frequent = 5, frequent = 4, occasionally = 3, rarely = 2, and

never = 1. Additionally, they were also to assess from a five-point Likert scale the extent to which the communication outcomes related to the PS features. Out of the total 264 questionnaires distributed, a total of 208 valid responses were received from various project team leaders on mass housing construction sites belonging to GREDA. By using structural equation modeling (SEM) aided by EQS version 6.2 software due to its superior advantage of exploring the causal relationships among multiple independent and dependent variables over other multivariate analytical tools such as Analysis of Variance (ANOVA), Multiple Regression (MR), and General Linear Modeling (GLM) [38, 39], the contribution of the PS features of MHPs to information flow and information composition communication ineffectiveness was explored. In the analytical approach, the unique PS features were denoted as the independent variable whereas the information flow and composition communication ineffectiveness were denoted as the dependent variables. The data characteristics and the data analytic approach are presented in the following section.

4. Model Assessment and Testing

Given the already established factor structure of the two main constructs in the model in respect of the procurement systems features of mass housing projects and the communication ineffectiveness in respect of information flow and information composition among the MHP team, confirmatory factor analysis (CFA) was used to test the procurement system features for construct and convergent validity [40, 41]. Preliminary assessment of the data revealed nonnormality; hence, the construct parameters were estimated using the Robust Maximum Likelihood (RML) method [39, 40, 42, 43]. This was because the Mardia value being 3.842 is a significant deviation from normality and thus the Robust Satorra-Bentler Scaled statistics in the RML are found to have the ability to perform adequately under such conditions to yield satisfactory results in nonnormal data [38, 39, 41, 43, 44]. The extent to which the constructs hypothetically relate to one another was assessed through the construct validity to establish the score reliability [43, 44]. This is considered as critical in testing measurement invariance (MI) between indicator variables and this is a significant prerequisite in structural equation modeling (SEM) [38, 41, 43, 44].

It useful in verifying that the factors are measuring the same underlying latent construct within the same condition and by that the MI help in ensuring that the attributes are relating to the same set of observations in similar way. Through a preliminary CFA, the MI for the procurement systems features on MHPs was determined based on examination of the residual covariance matrix from the CFA output result. From the results, the covariance matrix established the variables that adequately measure the MHP procurement systems features construct. The indicator variables having high residual covariance matrix (>2.58) which are considered unacceptably high were not included, suggesting they do not adequately measure the procurement systems features on MHPs [38, 41, 43, 44]. Hence accepting a variable to be ascribed as being well-fitting in the measurement of a construct, like the case of the procurement systems features on MHPs, the distribution of residuals covariance matrix should be symmetrical and centered around zero [41, 43–45].

4.1. Measurement Model for Procurement System Features (PS). A total of 208 responses were received from the survey and were thus used for the analysis. From a preliminary observation of the data, the variables PS1 and PS3 had the residual covariance matrix scores being unacceptably high scores (values ranged from 3.25 to 6.39) and were subsequently dropped from further CFA analysis [44, 45]. Hence only four indicator variables were thus accepted for the assessment of the procurement system features on MHP measurement model goodness-of-fit. With the already justified choice of the use of the RML method, the Bentler-Weeks structure representation for the approved construct revealed that the PS construct had 4 dependent variables, 5 independent variables, 8 free parameters, and 5 fixed nonzero parameters suggesting a well specified model [38, 39, 43]. Hence the model was then subjected to detailed CFA analysis and the results presented in Table 3.

Consequently, from Table 3, the sample data on PS model yielded an S – Bχ^2 of 9.351 with 2 degrees of freedom and an associated p value of 0.0839 for the analysed sample of 208 cases. Ideally, for a model that fits the data, the χ^2 or S – Bχ^2 would not be significant ($p > 0.05$) [39, 40]. This is an indication that the chi-square value being greater than 0.05 suggests that the difference between the sample data and the postulated PS factor model was not significant. Hence, it can be concluded that there is no significant difference and discrepancy between the sample data and the population and thus the fit function is good and well specified leading to retaining the model [38]. Additionally, the ratio of S – Bχ^2 to the degrees of freedom (normed chi-square) was determined to be 4.675, which was lower than the upper limit value of 5.0 and thus described as an acceptable fit [38, 40].

Also, from Table 3, the robust GFI and CFI indexes were both 0.998 which are said to be very close to the upper limit value of 1.00. A model is described as a good fit when the CFI and GFI are above the cut-off value of 0.95 [38–40]. Similarly, a very good fit model will have the RMSEA and SRMR values up to 0.05. The results in Table 3 were 0.002 and 0.008, respectively. With the acceptable values of SRMR and RMSEA, there is an indication of a good fitting model for the PS factor. Furthermore, from the results in Table 3, the Z-test statistics were all greater than the minimum threshold of 1.96 and their accompanying probability levels at 5% were all significant [38, 39, 43, 46]. Hence with the standardized coefficient values yielded being less than 1.00 as well as the Z-test statistics being statistically significant, it can be concluded that the estimates are reasonable and appropriate for the model PS factor.

Also the factor loadings were above the minimum value of 0.5 indicating that the results are good indicators of construct validity [38, 39, 46]. Kline [38] and Bentler [39] suggested that support is provided for convergent construct validity when each item has outer factor loadings above 0.70 and when each construct's average variance extracted (AVE)

Table 3: Constructs and final Items (procurement systems (PS) features).

Code	Unstandardized coefficient (λ)	Standardized coefficient (λ)	Standard error	Factor loadings	Z value	R square	Sig-value	Remarks	Cronbach Coefficient	Rho Coefficient
PS2	0.654	0.674	0.045	0.674	14.533	0.646	0.000		0.705	0.723
PS4	0.552	0.503	0.048	0.503	11.501	0.352	0.000			
PS5	0.644	0.642	0.044	0.642	14.591	0.672	0.000			
PS6	0.632	0.514	0.051	0.514	12.392	0.504	0.000			

Robust fit indexes for procurement systems (PS) features

Fit index	Cut-off value	Estimate	Remarks
S – Bχ^2		9.3512	
df	$x > 0.00$	4	Acceptable fit
CFI	$x \geq 0.90$ (acceptable), $x \geq 0.95$ (good fit)	0.998	Good fit
GFI	$x \geq 0.90$ (acceptable), $x \geq 0.95$ (good fit)	0.998	Good fit
SRMR	$x \leq 0.08$ (acceptable), $x \leq 0.05$ (good fit)	0.008	Good fit
RMSEA	$x \leq 0.08$ (acceptable), $x \leq 0.05$ (good fit)	0.002	Good fit
RMSEA 90% CI		(0.000, 0.078)	Good fit
p value	$x \geq 0.05$	0.839	Good fit

Robust statistical significance at 5% level; * parameter estimates are based on standardized solutions.

is 0.50 or higher. Hence it can be expressed succinctly that an AVE of 0.50 shows that the construct explains more than half of the variance of its indicators. The R^2 values were all greater than 0.50. This means that the variance extracted for each of the variables in the construct exceeded the suggested threshold of 0.50, indicating that the variance captured by a variable was larger than the variance due to measurement errors [38–40, 46]. Hence, the overall results suggest that the indicator variables adequately and considerably predict the factor construct.

Additionally, Cronbach's Alpha and Rho Coefficients for the construct were found to be 0.705 and 0.723, respectively. With both values being greater than 0.7, it is an indication of a high level of internal consistency and reliability in the factor construct [38, 46]. Hence, it can be deduced that, with the residual covariance estimates falling within the acceptable range, the robust fit indexes having a good fit, as well as all parameter estimates being statistically significant and feasible, the procurement systems (PS) factor can be said to have a good fit and thus can be acceptable for inclusion in the full model.

4.2. Analysis of Project Team Communication Performance Effectiveness (PCE) Outcome Factor (Information Flow). The initial preliminary CFA analysis conducted on the seven (7) variables defining the project team communication ineffectiveness associated with information flow revealed that the variables PCE10, PCE12, and PCE15 had the residual covariance matrix scores being unacceptably high scores (values ranged from 4.16 to 5.99) and were subsequently dropped from further CFA analysis [44, 45]. Hence only four indicator variables were thus accepted for the assessment of the project team communication performance effectiveness (PCE) outcome factor (information flow) on MHP measurement model goodness-of-fit. The examination of the Bentler-Weeks structure representation for the accepted four (4) indicator factors indicated 4 dependent variables, 5 independent variables, 8 free parameters, and 5 fixed nonzero parameters from the detailed CFA analysis. This is an indication that the model is well specified [39].

Consequently, the robust fit indexes on the PCE outcome factor (information flow) yielded S – Bχ^2 of 20.054 with 6 degrees of freedom and the associated probability of 0.480 ($p \geq 0.05$) (see Table 4). This result reveals that the Satorra chi-square was insignificant and was thus an indication that the sample data adequately fit the data and was indicative of an acceptable fit [38, 39]. Additionally, the normed chi-square which is the ratio of the chi-square to the degrees of freedom was found to be 3.342. This ratio was lower than the upper limit of 5.0 [38, 39, 43, 45]. Hence, the factor model was therefore considered to be of an acceptable fit. The robust GFI and CFI indexes yielded 0.999 and 0.997, respectively, meeting the conventional cut-off of 0.95 and thus suggesting a good fit. The SRMR and RMSEA values of 0.024 and 0.001, respectively, were good fit results since they were less than 0.05 (see Table 4) [38, 45]. Additionally, the assessment of standard errors and the test statistics (see Table 4) revealed that all Z values were greater than the cut-off value of 1.96 and were significant and with acceptable standard error margins (less than 1.0). Also, all parameter estimates were greater than 0.5 which is an indication that the variables were found to be more associated with the PCE outcome factor (information flow).

In addition, the R^2 values were also found to be greater than the normally accepted minimum of 0.700 [47] except for

Table 4: Constructs and final items (project team communication performance effectiveness (PCE) outcome factor (information flow), endogenous factor).

Code	Unstandardized coefficient (λ)	Standardized coefficient (λ)	Standard error	Factor loadings	Z value	R square	Sig-value	Remarks	Cronbach Coefficient	Rho Coefficient
PCE3	0.662	0.691	0.058	0.586	11.414	0.478	0.000		0.711	0.836
PCE7	0.873	0.806	0.043	0.806	20.302	0.650	0.000			
PCE13	0.869	0.783	0.047	0.783	18.489	0.613	0.000			
PCE14	0.873	0.806	0.043	0.806	20.302	0.650	0.000			

Robust fit indexes for project team communication performance effectiveness (PCE) outcome factor (information flow), endogenous factor

Fit index	Cut-off value	Estimate	Remarks
S – Bχ^2		20.054	
df	$x > 0.00$	6	Acceptable fit
CFI	$x \geq 0.90$ (acceptable), $x \geq 0.95$ (good fit)	0.999	Good fit
GFI	$x \geq 0.90$ (acceptable), $x \geq 0.95$ (good fit)	0.997	Good fit
SRMR	$x \leq 0.08$ (acceptable), $x \leq 0.05$ (good fit)	0.024	Good fit
RMSEA	$x \leq 0.08$ (acceptable), $x \leq 0.05$ (good fit)	0.001	Good fit
RMSEA 90% CI		(0.000, 0.125)	Acceptable fit
p value	$x \geq 0.05$	0.480	Good fit

Robust statistical significance at 5% level; * parameter estimates are based on standardized solutions.

PCE3. Hence it can be said that the factor adequately explains and predicts the variance in the indicator variables. However, with PCE3 accounting for about 25% (0.478) variance could also be seen as acceptable [40, 46]. The results therefore suggest that the indicator variables significantly predict the factor construct as almost all the variables are significantly associated with project team communication performance effectiveness (PCE) outcome factor (information flow). Also, the Rho Coefficient and the Cronbach's Alpha Coefficient revealed to be 0.836 and 0.711, respectively, which were higher than the recommended acceptable value of 0.7 [38, 43, 46]. This suggests a high degree of internal consistency and homogeneity (see Table 4). Against this, it can be concluded that the assessment of the PCE information flow outcome factor indicate an adequate fit for the sample data and the parameter estimates. Likewise, the test statistics yielded satisfactory results at 5% level. Hence the factor model was accepted for inclusion in the full latent model.

4.3. Analysis of Project Team Communication Performance Effectiveness (PCE) Outcome Factor (Information Composition). The initial preliminary CFA analysis conducted on the nine (9) variables defining the project team communication ineffectiveness associated with information composition revealed that the variables PCE1, PCE4, PCE9, and PCE11 had the residual covariance matrix scores being unacceptably high scores (values ranged from 3.92 to 7.22) and were subsequently dropped from further CFA analysis [44, 45]. Hence only four indicator variables were thus accepted for the assessment of the project team communication performance effectiveness (PCE) outcome factor (information flow) on MHP measurement model goodness-of-fit. Project team communication performance effectiveness (PCE) outcome factor (information composition) construct was further subjected to detailed CFA analysis to determine the acceptance or otherwise of the construct into the full model. Examination of the Bentler-Weeks structure representation for the five variables adopted from the preliminary CFA test revealed 5 dependent variables, 6 independent variables, 10 free parameters, and 6 fixed nonzero parameters for the PCE outcome factor (information composition) construct. The presence of some fixed parameters and some free parameters to be estimated from the data is an indication that the submodel is well specified [38, 39, 45]. Hence, the model was subsequently subjected to detailed CFA analysis [37, 43].

The robust fit test presented in Table 5, revealed the S – Bχ^2 as 11.9693 with 9 degrees of freedom with an associated p value of 0.190 for the analysed sample of 208 cases. From this, it can be suggested that the difference between the sample data and the postulated PCE information composition factor model was insignificant and thus the data adequately fit the model [38, 43, 46]. Also, the robust GFI, SRMR, and RMSEA were all found to meet the good fit threshold (see Table 5). However, the robust CFI index of 0.874 was found to be slightly less than the cut-off value for a good fitting model. Hence by drawing on the SRMR, GFI, and RMSEA good fit results, the model was subsequently accepted to have sufficient fit.

From the results in Table 5, the Z-test statistics were all found to be greater than the minimum threshold of 1.96

Table 5: Constructs and final items (project team communication performance effectiveness (PCE) outcome factor (information composition), endogenous factor).

Code	Unstandardized coefficient (λ)	Standardized coefficient (λ)	Standard error	Factor loadings	Z value	R square	Sig-value	Remarks	Cronbach Coefficient	Rho Coefficient
PCE2	0.823	0.720	0.083	0.720	9.916	0.561	0.000			
PCE5	0.803	0.904	0.049	0.904	16.390	0.821	0.008			
PCE6	0.772	0.871	0.067	0.871	11.443	0.786	0.000		0.842	0.898
PCE8	0.825	0.866	0.080	0.866	10.301	0.701	0.000			
PCE16	0.837	0.945	0.034	0.945	24.611	0.856	0.000			

Robust fit indexes for project team communication performance effectiveness (PCE) outcome factor (information composition), endogenous factor

Fit index	Cut-off value	Estimate	Remarks
S – Bχ^2		11.9693	
df	$x > 0.00$	9	Acceptable fit
CFI	$x \geq 0.90$ (acceptable), $x \geq 0.95$ (good fit)	0.874	Acceptable fit
GFI	$x \geq 0.90$ (acceptable), $x \geq 0.95$ (good fit)	0.981	Good fit
SRMR	$x \leq 0.08$ (acceptable), $x \leq 0.05$ (good fit)	0.048	Good fit
RMSEA	$x \leq 0.08$ (acceptable), $x \leq 0.05$ (good fit)	0.043	Good fit
RMSEA 90% CI		(0.000, 0.095)	Acceptable fit
p value	$x \geq 0.05$	0.19	Good fit

Robust statistical significance at 5% level; * parameter estimates are based on standardized solutions.

at a probability level of 5% and their associated sig-values were all significant [43]. The standard errors were also acceptable as none was negative and greater than 1.0. Also, all standardized parameter estimates (factor loadings) showed high associations (0.7 and above) suggesting an acceptable level of convergent validity [38, 46]. In addition, R^2 values which examine the degree of predictive accuracy between the factor construct and the indicator variables were found to be above 0.7 and close to the desired value of 1.00 as perfect prediction [46, 48]. All variables except for variable PCE2 had their R^2 above the conventional 0.7. The variable PCE2 had its R^2 above 0.5 which is also considered an acceptable moderate level of predictive accuracy [40, 46, 48].

The results therefore suggest that the indicator variables predict the factor construct adequately. Also, the Rho Coefficient and the Cronbach's Alpha Coefficient being 0.898 and 0.842, respectively, which are above the 0.7 conventional desired level are indication of acceptable level of internal consistencies and reliability [38, 40, 43, 46]. From the CFA test presented, it could be deduced that the residual covariance estimates and the robust fit indexes met the cut-off index criteria and also the parameter estimates yielded reasonable, feasible, and statistically significant results. Hence the project team communication performance effectiveness (PCE) factor (information composition) construct model had an adequate fit to the sample data and was indeed accepted for inclusion into the full latent model.

5. Model Estimation and Results

5.1. Testing the Influence of Procurement System Features (PS) on Mass Housing Project Team Communication Ineffectiveness (Information Flow and Composition). The summary of the variables were as follows: communication ineffectiveness (information flow) PCE (4 indicator variables); communication ineffectiveness (information composition) PCE (5 indicator variables); PS (4 indicator variables) (see Table 7). Subsequently, Z-scores, test of significance, path coefficient, coefficient of determination (R^2), Rho Coefficient and Cronbach's Alpha were assessed on the full identified structural hypothesized model (Figure 2) as conventionally required in SEM analysis [38, 40, 46]. The Robust Maximum Likelihood (RML) estimation approach was adopted due to its ability to adjust for the effect of nonnormality in the data to yield trustworthy and unbiased results compared to the transformation approach which can lead to loss of model power [38, 39, 41]. Likewise, by convention in RML estimation approach, first latent variable in each construct (factor) in the model factor was set to a fixed value of 1.0 in order to set the metric scale for that factor [38]. The other variables in each factor were consequently set as free parameters to be estimated through iterative procedures to minimize certain discrepancy or fit function between the observed covariance matrix (data) and the model implied covariance matrix [38, 42].

Following this, the total 208 responses realized from the survey were used in the model estimation process due to the absence of any missing values. According to Wong [42] and Lei and Wu [49], properly specified and estimated model will always converge, giving feasible and interpretable results as well as having free and fixed parameters. The full confirmatory factor analysis of the identified model evaluating the contribution of the PS features of mass housing projects (exogenous variables) to project team communication ineffectiveness in relation to information flow (endogenous variables) and information composition (endogenous

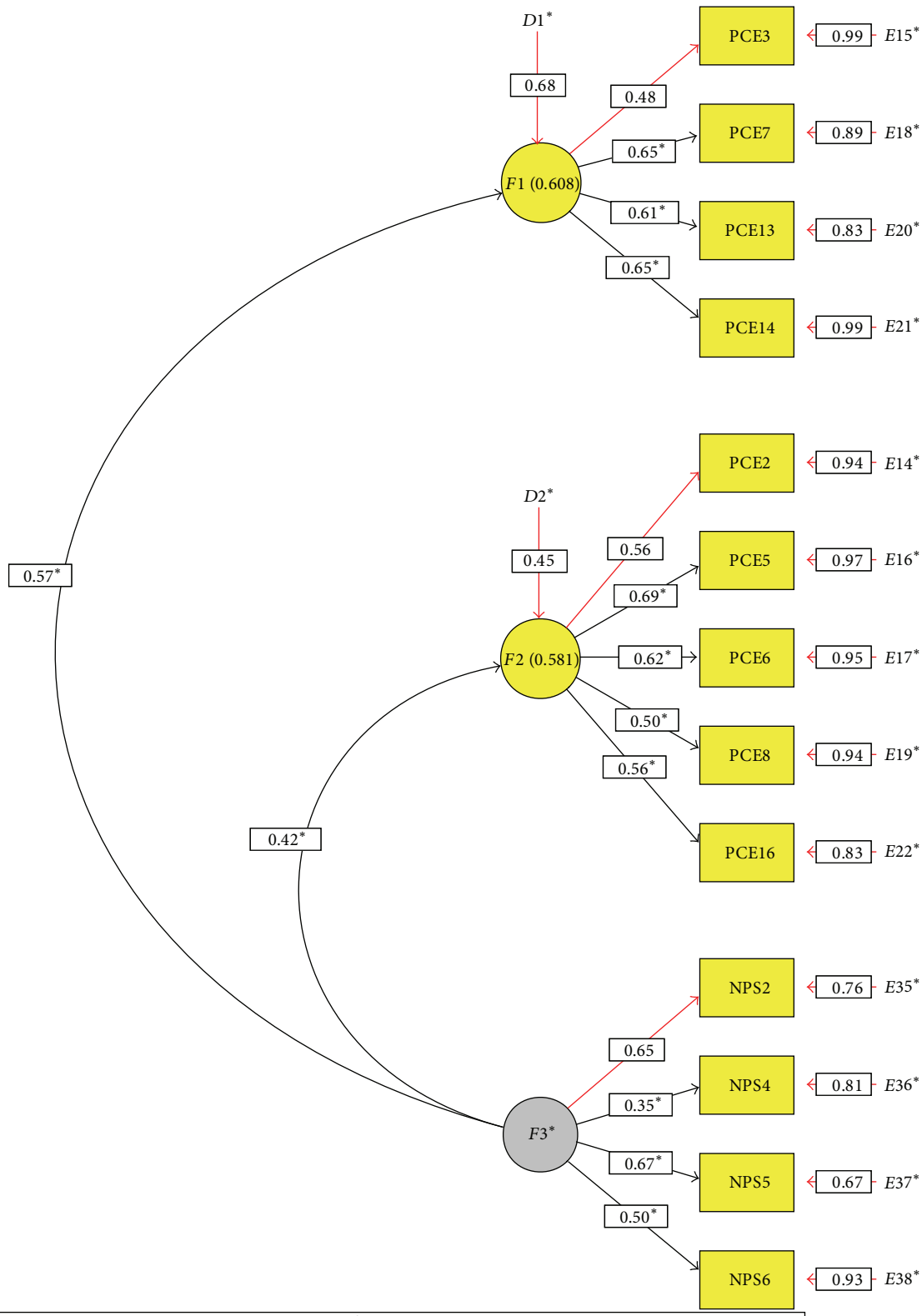

Figure X: EQS 6 final 200 nps phd.eds $\chi^2 = 178.22$ $p = 0.00$ CFI = 0.97 RMSEA = 0.06

Figure 2: Results of the information flow and information composition communication ineffectiveness model.

Table 6: Robust fit indexes for structural model testing contribution of mass housing features to information flow and information composition.

Robust fit indexes for project team communication performance effectiveness (PCE) outcome factor (information flow)			
Fit index	Cut-off value	Estimate	Remarks
χ^2		178.216 on 63 degrees of freedom	
S – Bχ^2		186.206 on 63 degrees of freedom	
df	$x > 0.00$	63 (normed = 2.828)	Acceptable fit
CFI	$x \geq 0.90$ (acceptable), $x \geq 0.95$ (good fit)	0.972	Good fit
RMSEA	$x \leq 0.08$ (acceptable), $x \leq 0.05$ (good fit)	0.062	Acceptable fit
RMSEA 90% CI		(0.081, 0.113)	Acceptable fit
p value	$x \geq 0.05$	0.000	

variables) was conducted. Bentler [39] indicated that a well specified and identified model will always have free, nonzero, and fixed parameters and converge as well. From the CFA results, the Bentler-Week structural representation revealed 15 dependent variables, 16 independent variables, 28 free parameters, and 18 nonzero parameters. Likewise, the model converged at the 17th iteration. These suggest that the structural model measuring the project team communication ineffectiveness on MHPs is well specified and identified [39].

In evaluating the fit of the model and the estimates of the parameters, the covariance matrixes realized, the unstandardized and standardized average off-diagonal residual were 0.0302 and 0.0681, respectively. According to Bentler [39], residual covariance matrix assesses the discrepancies between the matrixes to be modeled, usually the sample covariance matrix and the model (population) covariance matrix. Hence, an acceptable model with no collinearity issues among the variables, will have their average absolute residual values and average off-diagonal residual values for both unstandardized and standardized matrixes to be usually small (usually centered around 0.00) if the model is a good representation of the data [38]. Against this, the unstandardized and standardized average off-diagonal residual realized are indication of a structural model that could be described as well-fitting as the distribution of residuals is deemed symmetrical and centered around zero [43]. From the above information, the results suggest that the overall hypothesized structural model evaluating both information flow and information composition had a good fit to the sample data. Subsequently, further tests were necessary for the acceptance or the rejection of the model [38, 39].

The chi-square index, Comparative Fit Index (CFI) and the Root Mean Standard Error of Approximation (RMSEA) robust fit indexes were used for further test of the good fit of the model [38, 39, 43, 45]. The chi-square indexes suggested that the difference between the hypothesized model and the sample data matrix was significant ($p < 0.05$) (see Figure 2). However, the high sensitivity of the chi-square test to sample size and normality of data makes it an inadequate test statistics and thus not very reliable [38, 44]. Against this, a normed chi-square value is usually adopted by most researchers and is thus very symbiotic and conventional to the Robust Maximum Likelihood method [38, 39, 43, 45]. The normed chi-square is the procedure of dividing the χ^2 by the degrees of freedom. From the summary of the goodness-of-fit analysis presented in Table 3, the χ^2 yielded 178.216 with 63 degrees of freedom (df) and associated probability of $p = 0.000$. Consequently, the normed chi-square value (χ^2/df) was 2.828. Kline [38] suggested that a normed value up to 3.0 is considered good fit whereas a value up to 5.0 is an acceptable fit. Hence the normed chi-square values fell within the acceptable limit of 3.0 and are thus suggestive of good fit and thus the hypothesized model in Figure 2 reasonably and adequately fit the sample data [38, 39].

Additionally, the Comparative Fit Index (CFI) and the Root Mean Standard Error of Approximation (RMSEA) robust fit indexes in Table 6 indicated acceptable and good fit levels of the model and thus an indication of good conditions for the model acceptance. Likewise, the Rho Coefficient and the Cronbach's Alpha Coefficient were examined in order to establish score reliability and consistency for the model. The Rho Coefficient was 0.744 whereas the Cronbach's Alpha Coefficient was 0.701. This is an indication that these values met the minimum acceptable cut-off of 0.7 suggesting that the internal consistency and reliability in the measures were acceptable [38, 42, 46]. These results indeed offer a testament to the fact that the responses given are consistent across all indicator variables and thus the measures of the contribution of the unique PS features to MHP team communication ineffectiveness are deemed consistent. Subsequently, the test statistics reported in Table 7 were all greater than the conventional lower limit of 1.96 based on the probability level of 5%, thus suggestive of significant parameters in the models [38, 39]. The construct validity for the model was determined by examining the magnitude of the parameter coefficients. High parameter coefficients of values greater than 0.5 indicate close relation between the factor and an indicator variable. From the results presented in Table 7, the standardized parameter coefficient of all variables in the models could be explained as being significantly high above 0.5. This is an indication of a good fit between the indicator variables and the factors contained in the model [46].

5.2. Results of the Evaluative Structural Model Hypothesis Testing. The prime significance to SEM analysis is how best

Table 7: Factor loadings, Z-statistics, variance accounted for and reliability and construct validity of model testing (information flow and composition).

Indicator variable	Standardized coefficient (λ)	(Z values)	R squared (R^2)	Path coefficient	Cronbach's Alpha	Rho Coefficient	Significant at 5% level?
NPS2	0.674	0.674	0.646				Yes
NPS4	0.503	11.501	0.352	0.608 (0.581)*			Yes
NPS5	0.642	14.591	0.672				Yes
NPS6	0.514	12.392	0.504				Yes
PCE3	0.691	0.691	0.478				Yes
PCE7	0.806	20.302	0.650	0.571	0.701	0.744	Yes
PCE13	0.783	18.489	0.613				Yes
PCE14	0.806	20.302	0.650				Yes
PCE2	0.720	0.720	0.561				Yes
PCE5	0.904	16.390	0.691				Yes
PCE6	0.871	11.443	0.620	0.424			Yes
PCE8	0.866	10.301	0.501				Yes
PCE16	0.945	24.611	0.562				Yes

(0.581)* Path coefficient of information composition ineffectiveness.

the model generated is feasible as well as how the obtained solution satisfies the hypothesis being tested [38, 47]. Here in this study, the crux remains to be the testing of the hypothesis to explain the contribution of the unique PS features of mass housing project to project team communication ineffectiveness that are related to information flow and information composition (see Figure 1). The solutions obtained on the statistical significance of the parameter estimates and the test statistics to judge the feasibility of a model are presented in Table 4. The standardized parameter estimates and the test statistics (Z-test) obtained in the solution revealed that the parameter estimates were reasonable in terms of their magnitude, signs, and statistical significance and thus deemed adequate in the measures.

Iacobucci [40], Hair et al. [46, 50], and Frank and Hennig-Thurau [51] revealed that an R^2 value less than 0.100 is counted as an insignificant effect on the endogenous variable. This means that, in evaluating the contribution of the unique PS features of mass housing to project team communication ineffectiveness in relation to project related information flow, the results in Table 4 and Figure 2, the factor loadings and effects, indicate that the factor PS contributes about 57% (0.57) and 42% (0.42) to variance in information flow and composition ineffectiveness, respectively. The factor loading of each of the unique PS feature factors on the overall project team communication ineffectiveness (endogenous variable) in relation to information flow is contained in Table 4 and Figure 2. The factor loadings are the composite effect of the factor (R^2) on the endogenous variable which is interpreted as the model's predictive accuracy and thus represents the exogenous variable's combined effect on the endogenous variable(s) [46]. According to Hair et al. [46], this effect ranges from 0.00 to 1.00 with 1.00 suggesting an absolute predictive accuracy. It is further indicated that R^2 values of 0.75, 0.50, and 0.25, respectively, describe substantial, moderate, or weak levels of predictive accuracy [48, 50].

Analysis of the model suggests that PS has the strongest effect (contribution) on information flow related communication ineffectiveness among the project team compared to information composition. Subsequently, the results of R^2 in the information flow communication ineffectiveness revealed that *PCE7, late delivery of needed communicated information; PCE13, difficulty in disseminating information among project team; and PCE14, difficulty in accessing communicated information from channels* emerged as the dominant communication ineffectiveness ($R^2 > 0.5$) that occurs among the project team inherent from the influence of the PS features. Additionally, it can be suggested from the results that though information composition ineffectiveness among the project team inherent in the unique PS features was about 42% and can thus be deemed moderate compared to information flow ineffectiveness. Information composition ineffectiveness, *PCE2, lack of consistency in communicated information leading to lack of coordination among project team, PCE5, receiving conflicting information from team participants, PCE6, lack of clarity in communicated information resulting in different interpretations, PCE8, misunderstanding of communicated information,* and *PCE16, lack of defined roles and responsibilities among members of the team leading to communication failure* were the frequent information composition communication ineffectiveness among the team on mass housing.

The Results from the SEM analysis yielded support for the hypotheses, and thus it could further be suggested that the experience of mass housing project team communication ineffectiveness in relation to project related information flow induced by the unique PS feature is more intense or greater compared to that of information composition. Conclusively, the overall results therefore suggest that the exogenous variables (unique PS features of mass housing projects) considerably influence the endogenous variable (project team communication ineffectiveness).

5.3. Discussions of Results. The measure of the contribution of the network of procurement features contribution to overall communication effectiveness was assessed based on the unit effect of the project team composition, subcontracting style adopted, control and monitoring strategy, and the "prospective buyer" involvement in the construction process under scheme to project related information flow and information composition. From the results in Table 4, the procurement network systems adopted on mass housing project induce about 57% of the overall communication ineffectiveness related to information flow whereas, on information composition ineffectiveness, it accounts for about 42% of the overall variation. These influences can be termed as very substantial [46].

From these effects to the overall communication ineffectiveness among the project team on mass housing projects, the variables project team composition adopted on the housing scheme under management, control, monitoring, and coordination style in subcontracting on housing units under scheme, and prospective buyer involvement in the construction process under scheme are said to be making substantial contribution to the impact of the factor to the overall communication ineffectiveness. The impact of subcontracting style adopted across housing units under scheme to the mass housing project team communication ineffectiveness is seen to be moderate. Xie [22] and Liu [27] revealed that the procurement systems adopted on construction projects significantly influence the contractual and communication relationship complexities among the project team and participants. Xie [22] also revealed that traditional construction projects suffer communication problems in inaccuracy and incompleteness as a result of complex procurement team relationships. The study further established that communication issues of procedure were nonexistent. Liu [27] studying construction projects in Hong Kong also revealed that misunderstanding, inaccuracies, and information underload were common among the project team especially between the consulting team and the contractor. He again affirmed that issues related to procedure were not common.

Here in this study, the dominant communication ineffectiveness experienced among the team induced by this feature was late delivery of information, barriers to accessing information, and difficulty in disseminating (procedure) information in respect of information flow. In the area of information composition related communication ineffectiveness, the communication problems induced were inaccuracies, distortions, misunderstanding, and procedure. According to Enshassi [3], housing projects require an effective coordination system to facilitate the strategic planning by clearly understanding the habits and styles of prospective clients and ability to resolve problems related to the needs. It can thus be stressed that all effective coordination activities are communication dependent. In recent times in the mass housing industry in Ghana, the focus has shifted from speculative production to identifying prospective buyers and building to suit their needs. This means that the inputs, needs, and involvement of the buyer are significant from the beginning. Syed et al. [21] studying user participation in housing development in Malaysia revealed that owner involvement increases delivery acceptance and success but not without problems. The inherent problems experienced were disputes, cost overruns from frequent changes due to lack of understanding, and managerial and communication breakdown.

Given that these clients may not be technically inclined could plausibly explain the misunderstanding problems related to the communication. Additionally, in the Ghanaian context, mass housing development companies and institutions use a blend of project team composition of either all team members from the developing organization or a mix of in-house members and external professionals to form the team or entirely external consulting team to oversee the development. These are likely to explain the emergence of communication problems related to procedure, misunderstanding, and barriers that could be explained by varying organizational cultural barriers and practices. Indeed the emergence of procedure as communication problem among the team is a testament of the uniqueness of mass housing projects as compared to the findings on traditional construction projects by Xie [22] and Liu [27]. Interestingly, the contribution of subcontracting to the communication ineffectiveness was identified to be moderate here. Drawing on the practical management perspective of housing development in Ghana, it could be suggested that mass housing projects adopt complex subcontracting arrangements compared to traditional building construction projects [52]. Brace et al. [53] explained that multilayer subcontracting is generally perceived as having a highpotential to influence managerial and communication complexities compared to single-layer subcontracting; hence this revelation needs further assessment.

Additionally, a plausible explanation to these developments in the context of the situation in Ghana is that practically significant proportions of the mass housing development organizations in Ghana rely on external project teams for their consulting and managerial functions. In most situations, there exist wide and significant variations in organizational cultures, language, and practices between the consulting firm and the development organizations. These differences could likely induce this information flow and composition ineffectiveness on the construction process leading to communication breakdown and misunderstanding.

6. Conclusions

Given the lack of studies on the nature and contribution of the unique features of mass housing to project team communication ineffectiveness, this study provides an empirical assessment of the influence of the procurement features of mass housing to the project team communication performance as an effort to bridge the knowledge gap. The study has provided an empirical assessment of the contribution of procurement features of mass housing projects to the communication performance among the project team in mass housing delivery. These findings go beyond the mere acknowledgement of the communication ineffectiveness on mass housing projects inherent from its unique characteristics and particularities [3].

The findings given here reveal that the project team composition adopted on the housing scheme under management, control, monitoring, and coordination style in subcontracting on housing units under scheme and "prospective buyer" involvement in the construction process under scheme significantly contributes to information flow and information composition related communication ineffectiveness among the project team. Additionally, the influence on information flow is greater than that of information composition. It further revealed that communication ineffectiveness among the team inherent from information flow was late delivery of information, barriers to information access, and procedures in information dissemination. On information composition, the dominant communication ineffectiveness were largely misunderstanding of information, inaccuracies, and lack of clarity in project related information shared. Notably, the communication ineffectiveness revealed here indeed affirms the uniqueness of MHPs as some of the communication challenges are prevalent on MHPs compared to traditional construction projects. Given the evidence of the significant contribution of the procurement attributes on mass housing project communication, it can clearly be suggested that the findings cannot be underestimated or ignored in mass housing delivery towards enhancing and communication effectiveness among the project team. Hence the findings here have implications to mass housing management and development in Ghana and other similar developing countries.

Considering the emergence of mass housing approach as dominant and veritable delivery strategies being advanced globally to curtail the growing housing deficits that confronts many countries, the insight given by this study provides an empirical knowledge base for mass housing practitioners to evolve, develop, and adopt suitable communication strategies, media, planning, and management to positively influence effective communication performance outcome among the project team towards success. Likewise, the insight into the contribution of the procurement features of mass housing in information flow and information composition to mass housing project team communication performance could also be deemed very useful towards continuous professional development agenda in communication skills among mass housing practitioners and the industry at large. Such skills are deemed very necessary in ameliorating the inherent communication ineffectiveness among the project teams in mass housing delivery.

Limitations of Study and Future Work

There are few limitations about the study which need highlighting. The key limitation of this study is the generalization and application of the knowledge generated by this study across various geographical regions and project typologies. The empirical data was collected in Ghana suggesting that the result and finding could only be generalized to Ghana context. It is thus important for readers to note that this should not nullify the application of the findings in other developing countries with similar cultural and practical characteristics of construction project management practices and construction project delivery. Also, studies such as Ahadzie et al. [14], Yi et al. [17], and Zairul and Rahinah [2] have revealed multiple construction sites, multiple geographical locations, and repetitive design contract packaging as other unique attributes of MHPs. Here, the findings presented are limited to the influence of only the procurement attributes.

In the light of these limitations further studies will be useful to advance the systematic understanding of the communication ineffectiveness inherent from these other unique attributes of MHPs. Also, similar studies in countries perceived to have similar characteristics in construction project management practices and mass housing delivery could be useful towards fully understanding the taxonomy of the contextual communication ineffectiveness inherent in the unique attributes MHPs.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

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