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Contribution of multiple construction site management features to project team communication effectiveness: the case of mass housing projects

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Studies have indicated that mass housing projects (MHPs) possess unique multiple site management features (MCS) that significantly induce communication challenges among the project team in its delivery. However, the paucity in these studies is the failure to determine the extent and nature of the communication challenges and ineffectiveness that are inherent in the multiple site management features of MHPs. Through the use of structured questionnaire survey, this study used structural equation modelling to determine the nature and extent of the contribution of the MCS features of MHPs to communication performance among the MHP team. The results showed that the MCS features of MHPs significantly induce both information flow and information composition communication ineffectiveness. The results further revealed misunderstanding, inaccuracies, distorted communication and difficulty in communication dissemination as the dominant inherent MCS communication ineffectiveness among MHP teams. The findings provide empirical support for the general hypothesis that multiple site management features of MHPs significantly contribute to project team information flow and information-composition-related communication ineffectiveness among project teams. The understanding of the related communication challenges inherent from the MCS features of MHPs is thus very essential towards evolving and adapting effective communication planning, management strategies, concepts and approaches necessary to engender managerial and communication efficiencies in mass housing delivery.

Keywords: Communication performance, mass housing, project features, SEM.

Introduction

Effective communication continues to dominate emerging literature as very crucial to achieving project goals and attaining project delivery successes (Muller, 2003; Henderson, 2008). In spite of this recognition, ineffective communication continues to dominate the causes of project failures in the construction industry (PMI, 2008; El-Saboni *et al.*, 2009; Skulmoski and Hartman, 2010; Azmy, 2012). The situation can be said to be very rife especially on projects of unique characteristics such as mass housing projects (MHPs) (Enshassi and Burgess, 1991; Enshassi, 1997). Ahadzie *et al.* (2014) indicated that MHPs exhibit multiple site management features that make them unique compared to traditional 'one-off' construction projects often encountered in the construction industry. Ahadzie *et al.* (2014) further posited that in spite of this recognition, the management intuition, inherent communication implications and challenges from this unique multiple site management features of MHPs are not well understood and rigorously researched. Blismas *et al.* (1998) also indicated that multiple site construction projects typically consist of a network of geographically disparate projects undertaken by a management team and thus offer heightened communication and managerial challenges. Gray and Hughes (2001) further hinted that MHPs are typically multiple sites in nature and this attribute induces communication and documentation challenges among the project team.

Generally, studies have widely acknowledged the lack of communication effectiveness that result in continuous loss of productive time on MHPs, which are primarily induced by the multiple site management nature and

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attributes (Enshassi, 1997; Ahadzie et al., 2014). Kamara et al. (2003) likewise indicated that the MCS of MHPs have interrelationship with goals, management strategies, delivery tactics, and communication concepts and approach. Against this, it is significant for practitioners to continually aim to improve their conceptual and theoretical understanding of the MCS attributes of MHPs and their implications for communication effectiveness towards engendering managerial efficiency and project success. However, in spite of the recognition of the significance of the understanding of the nature and extent of communication challenges inherent from such unique features of MHPs towards success, there are yet to be studies devoted to an empirical assessment of these inherent communication challenges. This is because notable studies such as Ahadzie et al. (2014), Enshassi (1997) and Gray and Hughes (2001) have only given acknowledgement to the fact that the MCS of MHPs induce communication challenges. The aim of this study is to investigate the contribution of the multiple sites management features of MHPs to project team communication performance. Precise understanding of the communication performance inherent in the multiple sites management features of MHPs is crucial towards project performance and delivery success.

Multiple sites management concepts and features of MHPs

Multiple sites for various housing units (MCS) remain a unique characteristic feature to MHPs and that several factors define this attribute (Blismas et al., 1999). Blismas et al. (1999) and Zairul and Rahinah (2011) revealed that the multiple site management features of MHPs are defined by the site management style, contractor management concept, computer application systems, health and safety management concept, quality management style as well as the reporting techniques and documentation style adopted. It is further posited that these attributes underlining the multiple site nature and management concept of MHPs have influence on the overall communication management intuitions of the housing projects especially on repetitive tasks (Blismas et al., 1999; Mahdi, 2004; Zairul and Rahinah, 2011).

Blismas et al. (1999) revealed that multiple site construction projects typically consist of a network of geographically disparate projects that are undertaken by a series of co-ordinated programme that must be managed by the team. Mead (1999) also revealed that multiple construction site projects adopt unique computer applications in its management and communication task performance. Zairul and Rahinah (2011) outlined that the management concepts in respect of health and safety, quality and site management on MHPs have significant interrelationship with goals, objectives, strategies and tactics in information sharing among project teams. Blismas et al. (1999) also suggested that the geographical disparity of MHPs exacerbates the complexity of management programmes in its delivery. Zairul and Rahinah (2011) and Mahdi (2004) further revealed that the attributes of contractor management style, the construction technology adopted on repetitive works on housing units and the change orders that are adopted on multiple housing units on multiple sites being managed are often unique. According to Zairul and Rahinah (2011) and Enshassi (1997), the MCS features of mass housing require a mechanism that can reduce uncertainty and equivocally improve communication performance among the project team and stakeholders. However, like other similar studies (see Enshassi, 1997; Ahadzie et al., 2014) on the causal phenomenon of the features of mass housing, they have failed to examine the nature and extent of the communication problems and challenges emanating from the contribution of the inherent unique project attributes and environment.

Effective communication performance is thus associated with project success, team effectiveness, and integration, which have direct performance outcomes and delivery implications for the project team (Enshassi, 1997; Azmy, 2012). The recognition of the urgent necessity for improvement in communication performance outcomes on MHPs have created the need for the urgent understanding and knowledge into the nature and extent of the adverse communication outcomes inherent from these unique multiple site and management attributes of MHPs (Enshassi, 1997; Ahadzie et al., 2014). A succinct representation of the review of literature on the multiple sites management concepts of MHPs revealed seven features summarized in Table 1.

Communication performance measurement indicators

The construction industry has long recognized communication performance measures as an important step towards identifying communication factors that impact on the communication outcome in order to adapt strategies to engender improvement (Thomas et al., 1998; Xie, 2002; Dainty et al., 2006). However, communication performance assessment has remained ambiguously defined and evaluated in the construction industry. Liu (2009) argued that communication performance has remained a very complex construct to describe, measure as well as witnessing very little effort and development on the subject in the construction industry. Notably, many studies on the subject

Table 1 Multiple sites and management style features of MHPs

Multiple construction sites and management style (MCS) features	Literature sources				
	1	2	3	4	5
Contractor management style adopted on housing units under scheme		√	√	√	
Site management style adopted on the housing units under scheme	√	√			√
Construction technology and method adopted for repetitive works in housing units under scheme			√	√	
Change orders (variation orders) procedures adopted on repetitive housing units under scheme	√				
Health and safety management techniques adopted for repetitive task construction works on housing units under scheme			√	√	
Computer application software(s) adopted by project teams on housing units under scheme	√				
Quality management style and approach adopted on housing units and overall scheme(s)		√		√	√

Note: 1 = Mead (1999), 2 = Blismas *et al.* (1999), 3 = Mahdi (2004), 4 = Zairul and Rahinah (2011), Ahadzie *et al.* (2014).

define communication performance as a standard for making qualitative and quantitative assessment of communicated task performed (Thomas *et al.*, 1998; Mead, 1999; Murray *et al.*, 2000; Dawood *et al.*, 2002). Additionally, in the construction industry, researchers have predominantly considered information timeliness, accuracy, completeness and satisfaction with coordination as the criteria for assessing communication performance. Guevara and Boyer (1981) evaluated communication performance among construction project team by using information distortion, gate keeping as well as information overload and underload as the main performance evaluation indicators. Watkinson (1992) and Shen (1992) reviewed communication deficiencies on construction projects by assessing the information overload, inaccuracies, inadequacies of shared information, misunderstanding, untimely information and information accessibility challenges as the underlining criteria.

Given this varied communication performance assessment criteria, the Construction Industry Institute (CII) in 1997 developed a six communication performance assessment criterion for the construction industry. This was known as the communication project assessment tool (COMPASS). The emergence and acceptance of the CII (1997) indicator approach is induced by the fact that the model incorporates communication variables from a humanistic viewpoint and social network for communication analysis. This is perceived to reflect the global construction project environment of social behavioural interactants. The effectiveness of the performance indicators is embedded in the two main assessment criteria of the communication task and the information flow process (CII, 1997). These indicators relate to the accuracy, timeliness, distortions, barriers, completeness (overload and underload) and procedures of the communication on the construction project (CII, 1997). From the development of the COMPASS in 1997, it has formed the basis and foundation of most communication performance assessments in the construction industry (see Thomas *et al.*, 1998; Mead, 1999; Dawood *et al.*, 2002; Xie, 2002; Liu, 2009; Xie *et al.*, 2010). From a comprehensive and critical evaluation of literature, it can be said that, though other studies have suggested other indicators of communication performance assessment in the construction industry, the CII (1997) has been seen to offer reliability in the measure of communication performance and communication effectiveness assessment. By drawing on the practical and theoretical perspective of the MHP environment and the traditional construction industry in Ghana, the communication performance indicators for this study were operationalized as indicated in Table 2.

Theoretical and conceptual background

The theoretical underpinning of communication performance measures lies in the fact that the assessment predominantly entails the relationship between variables which are usually complex and having multiple and intricate levels (CII, 1997; Thomas *et al.*, 1998; Xie *et al.*, 2010). From the perspectives of many researchers, the complex relationships of the variables in the communication performance measures have predominantly been perceived as causes in one study and effects in another study (CII, 1997; Liu, 2009; Xie *et al.*, 2010). However, it is strongly emphasized that the significant underlining fact in any measure is to carefully define the meaning, roles of the variables, and the relationship between them (CII, 1997; Xie, 2002; Liu, 2009). The attribution theory of communication performance deals with an important distinction between two main variables in a communication performance measures as causal factor and outcome indicator (see Weiner, 2006; Hsieh and Schallert, 2008; Salleh, 2008). From this perspective, these variables in communication performance measures have been classified as communication factors and communication

Table 2 Explanation of the communication ineffectiveness/problem variables

Indicators	Explanatory variables
Inaccuracies	Receiving conflicting information from team participants
	Lack of consistency in communicated information leading to lack of coordination among project team
	Lack of conciseness in communicated information among the project team
Untimeliness	Late delivery of needed communicated information
Distortions	Persistent change in meaning of communicated information
	Persistent change in content of communicated information
	Lack of clarity in communicated information resulting in different interpretations
	Lack of coherency in communicated information resulting in different interpretations
Barriers	Difficulty in accessing communicated information from channels
Underloading	Receiving less information than expected from team participants for tasks
Overloading	Receiving more information than necessary for the tasks
Misunderstanding	Misunderstanding of communicated information
Gate keeping	Witholding of part of the information by the one who controls communication
	Witholding of whole of the information by the one who controls communication
Procedure	Difficulty in disseminating information among project team
	Lack of defined roles and responsibilities among members of the team leading to communication failure

Source: CII (1997), Thomas *et al.* (1998), Mead (1999), Shen (1992), Xie (2002), and Liu (2009).

indicators (see CII, 1997; Thomas *et al.*, 1998; Xie *et al.*, 2000, 2010; Xie, 2002; Liu, 2009). The terms factors and indicators have often been used to denote terms which usually refer to variables of predictors and results, respectively. The choice of the attribution theory over other theories used in communication performance measures was motivated by this approach of investigating the causal relationship between variables of predictor roles and indicator attributes (Weiner, 2006). The factors are connoted as variables of predictors which influence the performance outcome (indicator variables). This has been extensively used in other similar studies (see Hsieh and Schallert, 2008; Salleh, 2008). In communication performance measure research in construction, Dawood *et al.* (2002), Liu (2009), Xie *et al.* (2010) and Xie (2002) contend that the variables of communication factors and communication performance indicators are not mutually exclusive and must both be considered for evaluating and judging communication performance.

From the attribution theory, the communication factors in the communication performance measures could either be internal factors or external factors (Weiner, 2006; Hsieh and Schallert, 2008; Salleh, 2008). The internal factors relate to the communication competencies of the communicators, whereas the external factors relate to the influence of the communication environment, task difficulty and the communication context. The multiple site management style features of MHPs are denoted as the external causal factors that significantly influence the communication outcome among the MHP teams in this study (Enshassi, 1997; Kwofie *et al.*, 2014). The communication performance indicators (see Table 2) were denoted as the communication outcome indicators. The decision to focus on the external factors denoted by the multiple site management style features of MHPs was mainly motivated by the objective of the study and the general lack of empirical studies supporting perceived communication ineffectiveness inherent in the unique MHP environment (see Enshassi, 1997; Ahadzie *et al.*, 2014). Additionally, Dainty *et al.* (2006), Marshall-Ponting and Aouad (2005) and Xie (2002) have argued and proved that an evaluation of communication performance measures in respect of information flow and information composition offer an in-depth and microscopic understanding and assessment of the influence of the communication factors. Likewise, it offers a good and sound basis for adopting strategies to ameliorate the adverse impact of the communication factors. However, the paucity is many studies (see Thomas *et al.*, 1998; Xie, 2002; Liu, 2009; Xie *et al.*, 2010) is the adoption of a composite approach to the evaluation where there is no distinction between the communication information flow and composition. Hence, here in this study, the decision was to adopt the communication flow and composition approach.

Advancing the theoretical foundation in the communication factor and communication indicators approach in communication performance measures further, the extent to which the multiple site management style features of MHPs contribute to the communication performance outcome among MHP team is therefore the evaluative causal effect on:

- communication information flow and
- communication information composition

Hence, the theoretical perspective of this study is that the communication effectiveness outcome among the MHP team is due to the contribution of the multiple site management style features of MHPs. The assessment of the Project Team Communication Effectiveness was undertaken by operationalized 16 variables in information flow and composition communication performance (see the appendix). This was conceived as the endogenous variables (Dependent Variable-Factor) in this study. The Project Team Communication Performance associated with the flow of information was defined by seven indicator variables while that associated with the composition of the information factor was defined by nine variables (see the appendix). The multiple site management style features was thus denoted as the exogenous variables (Independent Variable-Factor). The method and analysis of the empirical data to identify the contribution of the MCS features of MHPs to the Project Team Communication Effectiveness (PCE) is presented in the proceeding section.

Study methodology

From the critical appraisal of the literature reviews and the concepts in the communication performance measures, a mainly quantitative approach was adopted due to its suitability in similar causal relationship inquiry as well as being noted for its appropriateness for testing prior formulations and hypothesis (Fellows and Liu, 2008; Creswell, 2009). Though, communication performance measures could be done with communication performance records, the absence of general documented communication performance records and that inherent from the related multiple sites management style features of mass housing made the use of records impossible. Hence, primary data were collected through the use of survey questionnaires, drawn and designed based on the identified communication factors and indicators presented in Sections 'Multiple sites management concepts' and 'Communication performance measurement indicators'. The structured questionnaire was divided into two sections A and B. Section A elicited personal information on respondents, which includes years of experience in mass housing development and profession as project team leader. Section B related to objective of this research, which is to examine the contribution of the multiple sites management style features of MHPs to the team communication performance. The questions were asked on a conventional five-point Likert scale ranging from not very frequent to very frequent. In this section, respondents were to first indicate the frequency of the information flow and information composition communication challenges they experience among the team on mass housing. Additionally, they are to indicate the extent to which each of the information flow and composition communication problems are inherent in the multiple site management style features of MHPs.

The structured questionnaires were administered on project team leaders on mass housing construction project sites of active members of Ghana Real Estate Development Association (GREDA) in Ghana in a survey. GREDA is the umbrella organization of real estate mass housing developers in Ghana. The decision to focus on the project team leaders of MHP was underpinned by the fact that, practically, the overall assessment of the performance of the communication task function of the project team lies with the team leader (Dainty *et al.*, 2006; Ibrahim *et al.*, 2011). A total of 208 valid responses were received from various project team leaders on mass housing construction sites out of a total 250 questionnaires administered through a purposive sample of 192 active real organizations belonging to GREDA. The total 250 questionnaires were distributed even though the sampled size was 192 because majority of the organizations sampled had multiple housing scheme sites which were managed by different teams on each scheme. Structural equation modelling (SEM) was subsequently used in analysing the primary data elicited. According to Kline (2005), Byrne (2006) and Iacobucci (2010), SEM has a superior advantage of exploring causal relationships among multiple independent and dependent variables over other multivariate analytical tools such as linear general modelling (LGM) and multiple regression (MR). LGM and MR can explore relationship between multiple independent variables and a single dependent variable. In the study, drawing on the characteristics of the variables in the appendix, it could be said that the dependent variable (s) (information flow and information composition), which are the communication performance indicators, are multiple and thus this makes the SEM analytical approach most suitable.

Data analysis and results

Analysis of the background information

From the total of 208 responses realized at the close of the survey, professionals who were Project Managers acting as project team leaders on MHPs were 35, constituting 17% of the total respondents. Also, 57 project team leaders constituting 27% were Architects, whereas Quantity Surveyors as project team leaders were 82 (representing 40%). Similarly, 35 of the professionals acting as project team leaders on the MHPs were Civil Engineers (constituting 17% of the respondents). The results on the professional background of the respondents can be said to give a fair reflection and representation of potential MHP team leaders across the main professionals in a project team in the construction industry. Hence, this is an indication that the perceptions given by the project team leaders on the variables in the study are more likely to be balanced across the various professionals. Additionally, the experience of the project team leaders partaking in the survey showed that 11% (23 persons) had 0–5 years of experience in mass housing delivery. A total of 108 persons (52%) have had between 6 and 10 years of experience. Project team leaders having between 11 and 15 years of experience were 42 (20%), whereas 17% (35) had between 16 and 20 years of experience. A critical examination of the banded breakdown of the background experience of the respondents (i.e. ≤5 years, 6–10 years, 11–15 years, 16–20 years and over 20 years) indicate that 89% of the respondents (majority) have at least six years of experience in MHP delivery. In mainstream human resource management practice as well as drawing on the practical perspective of management practice and employment in Ghana, a minimum of six years of experience is considered adequate for senior management position while having 10 years and above is suitable for executive positions. Drawing on this, a plausible conclusion is that the respondents are well vested in the activities of mass housing delivery and are more likely to offer valid and reliable responses in the survey, hence given credence to the findings.

Analysis of the main data (SEM approach)

According to Hair *et al.* (2013), Kline (2005) and Byrne (2006), in SEM analysis, when the variables under consideration involves factor constructs with variables on each factor, separate analysis of the measurement and structural models in a two-step process is the most recommended approach. This is because such approach allows for the refinement of measures before testing of the structural model and is consistent with previous studies (Byrne, 2006; Franke *et al.*, 2008; Iacobucci, 2010). From the structure of the constructs in the appendix, it could be deduced that the parameters in this study contains three factors with MCS as the independent factor with seven variables and two dependent factors in respect of information flow (seven variables) and information composition (nine variables). Also given the already established structure of the factors in this study, the confirmatory factor analysis (CFA) was considered the most suitable as indicated by Kline (2005) and Hair *et al.* (2013). The empirical data collected was analysed using SEM with EQS 6.2 Version software by adopting CFA to test the independent and dependent factor structures to establish reliability and validity of the constructs using the robust maximum likelihood (RML) method (Bentler, 2005; Kline, 2005; Wong, 2011). Kline (2005) revealed that psychometric data have a high tendency to be non-normally distributed with a Mardia coefficient showing significant deviation from normality and thus, the Satorra–Bentler Scaled statistics (Robust) is often adequate to perform and yield reliable results under such conditions (Bentler, 2005). The RML also has the ability to deal with the slight non-normality in a data to yield trustworthy results over the transformation approach, which can lead to loss of model power (Bentler, 2005; Kline, 2005; Byrne, 2006; Hair *et al.*, 2014). The preliminary CFA and data characteristics assessment were conducted on the total 208 cases received as the responses in the questionnaire survey and the results revealed a Mardia coefficient of −1.8374, indicating a slightly significant deviation from normality (Bentler, 2005; Kline, 2005). This, however, became the underlining factor justifying the choice of the RML method in the analytical approach.

CFA is useful for examining validity of the constructs for the robustness of the structural model by observing the factor loadings and thus high factor loadings are indicators of good indicators of construct validity (Kline, 2005; Byrne, 2006; Hair *et al.*, 2013, 2014). This approach is consistent with Jung *et al.* (2008), Franke *et al.* (2008) and Iacobucci (2010). According to Hair *et al.* (2014), Byrne (2006) and Field (2005) communalities from 0.50 and above (≥ 0.50) are considered acceptable factor loadings suggesting that the variable adequately measures the construct. The CFA revealed that the variables MCS3, MCS5, MCS6, PCE1, PCE4, PCE9, PCE10, PCE11, PCE12, and PCE15 indicator variables emerged with an unacceptable level of communalities (< 0.50) (see the appendix) and were subsequently dropped, meaning that they do not sufficiently load their various constructs (Field, 2005) regardless of their importance and theoretical context of the study. In order for a variable to be included in a CFA analysis, thus enabling the model adequately measuring a construct and described as well-fitting, the communality scores must be more than 0.50 (Field, 2005; Kline, 2005; Hair *et al.*, 2013). Hence, the summary of the variables were: Communication Ineffectiveness (information flow) (Endogenous variable) PCE (four indicator variables); Communication Ineffectiveness (information Composition) (Endogenous variable) PCE (five indicator variables); Exogenous variables: MCS (four indicator variables) (see the appendix). The main hypothesis underlining the full structural model is that *Multiple Construction Sites Management Style (MCS) features* of MHPs *are* likely to contribute significantly to MHP team communication performance ineffectiveness (PCE) in relation to information flow and information composition in MHP delivery. The SEM model is presented in Figure 1. The structural hypothesized model estimation process used the total 208 cases for the analysis of the full latent variables for information flow and information composition (Figure 1). The summary of the results on the full hypothesized structural model (see Figure 1) is reported in Tables 3 and 4. The results entail the Z-scores, test of significance, path coefficient, coefficient of determination (R^2), rho coefficient and Cronbach's alpha, factor loadings, and goodness-of-fit on the structural hypothesized model (Figure 1). Kline (2005), Byrne (2006), Iacobucci (2010) and Hair *et al.* (2014) revealed that a single index goodness-of-fit source in SEM analysis is often associated with bias. Hence, in this study, goodness-of-fit was established by multiple indices to negate biases associated with the use of a single index by using the comparative fit test (CFI) and residual mean-square error of approximation (RMSEA) (Joreskog and Sörbom, 1996; Bentler, 2005; Kline, 2005; Hair *et al.*, 2014). However, even though the chi-square test (χ^2) is recognized as a measure of fit, it is frequently affected by the sample size and correlations within the model and can produce inaccurate probability values hence it was replaced with the normed chi-square test (χ^2/df), which is the chi-square divided by the degree of freedom with values of less than 3.0 being very good-fit (Kline, 2005; Byrne, 2006; Iacobucci, 2010; Hair *et al.*, 2014).

From the results in Table 3, CFI of 0.940 was found to be acceptable and a desirable fit. A model is said to be a good fit if the CFI is above the cut-off value of 0.90 (Kline, 2005; Hair *et al.*, 2014). The RMSEA with 90% confidence interval was 0.020. This value was found to be below the maximum value of 0.08 for a good-fit model and thus be considered a good fit for the model (Kline, 2005; Byrne, 2006; Hair *et al.*, 2014). Additionally, the normed chi-square value was found to be 2.42, suggesting a good-fit for the model (Kline, 2005; Byrne, 2006). The results of the fit indices suggested a good fit to the model and thus from these values, the final structural model was deemed acceptable since the hypothesized model adequately fits the sample data (Byrne, 2006; Iacobucci, 2010; Hair *et al.*, 2014). Figure 1 shows the final structural model and the associated path coefficients. Likewise, the rho coefficient and the Cronbach's alpha coefficient were examined in order to establish score reliability and consistencies for the full hypothesized structural model. The rho coefficient and the Cronbach's alpha coefficient examined in Table 4 indicated an acceptable level of internal consistency and reliability in the measures as they all approximately met the 0.7 desired level (Iacobucci, 2010; Hair *et al.*, 2013, 2014). These results indeed offer a testament to the fact that the responses given are consistent across all indicator variables and thus the measure of the contribution of the MCS features to MHP team communication ineffectiveness are deemed consistent. Subsequently, the test statistics reported in Table 4 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 (Kline, 2005; Byrne, 2006).

The construct validity for the SEM model was determined by examining the magnitude of the parameter coefficients. High parameter coefficients of values greater than 0.5 indicate a close relation between the factor and an indicator variable. A parameter coefficient of 0.5 is interpreted as 25% of the total variance in the indicator variable being explained by the latent variable (factor). Therefore, a parameter coefficient has to be between 0.5 and 0.7 or greater to explain about 50% of the variance in an indicator variable (Hair *et al.*, 2010, 2013). From the results presented in Table 4 and Figure 1, the standardized parameter coefficient of all variables in the models could be explained as being significantly high above 0.5. This is indicative of a good fit between the indicator variables and the factors contained in the models (Iacobucci, 2010; Hair *et al.*, 2013).

Contribution of the multiple site management style features to the project team communication ineffectiveness

The prime significance to SEM analysis is how best the model generated is feasible as well as how the obtained solution satisfy the hypothesis being tested (Kline, 2005; Wong, 2011). Here in this study, the crux remain the testing of the hypothesis to explain the contribution of the unique *Multiple Construction Sites Management Style (MCS)* features of MHP to project team communication ineffectiveness among the project team. Following the assessment of the goodness-of-fit of the structural model, a further inspection was done on the obtained solution and this involved the inspection of the statistical significance of the parameter estimates, and the test statistics to judge the feasibility of the model (see Table 4 and Figure 1) (Kline, 2005). 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 (Bentler, 2005; Kline, 2005; Byrne, 2006).

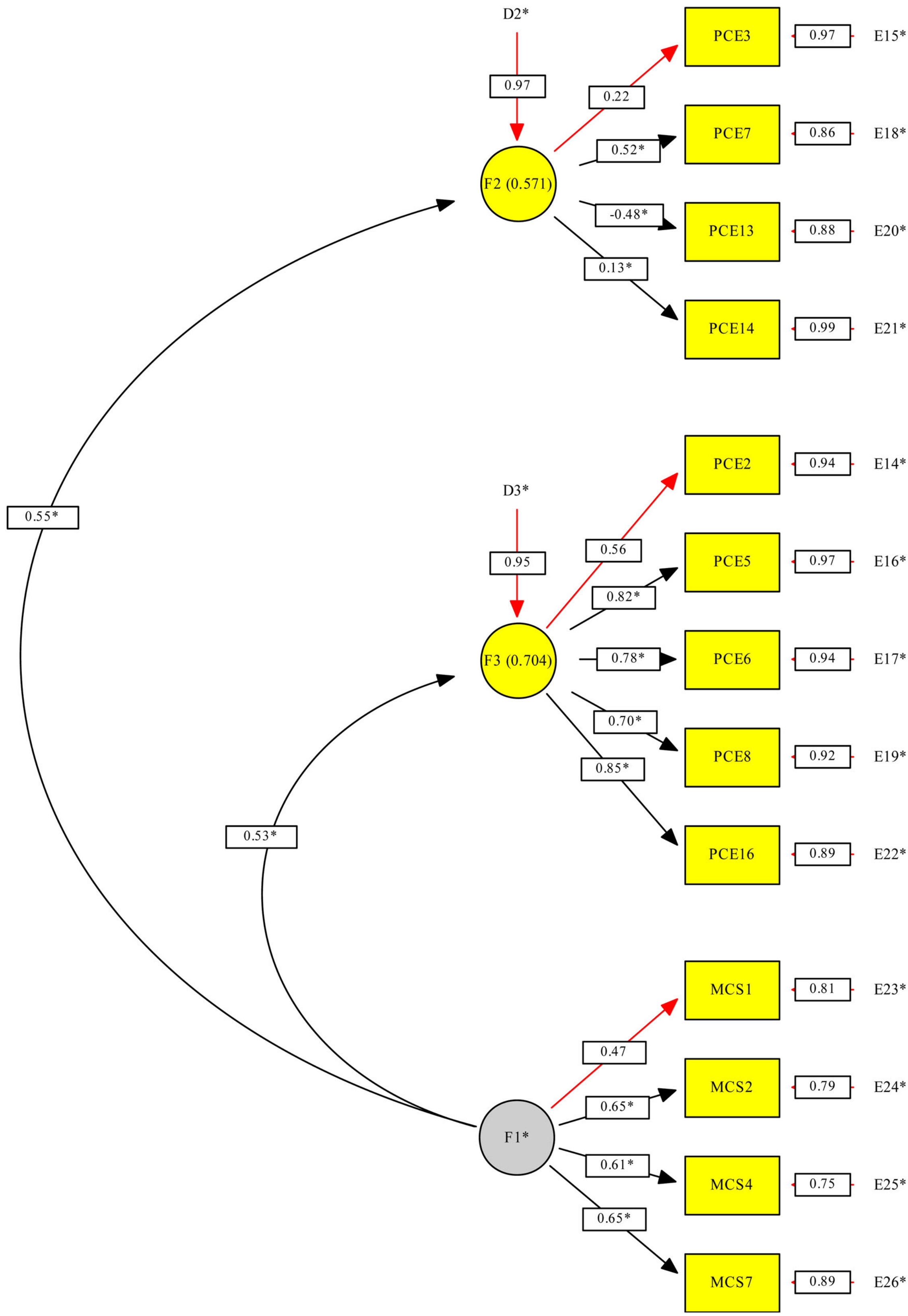

Figure 1 Results of the information flow and information composition communication ineffectiveness model. Note: $\chi^2 = 1180.71$, $p = .00$, CFI = 0.94, RMSEA = 0.02.

Table 3 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 and information composition)			
Fit index	Cut-off value	Estimate	Remarks
χ^2		152.426 on 63 degrees of freedom	
$S-B\chi^2$		157.6696 on 63 degrees of freedom	
df	$x>0.00$	63 (normed = 2.42)	Acceptable fit
CFI	$x\geq 0.90$ (acceptable) $x\geq 0.95$ (good fit)	0.94	Acceptable fit
RMSEA	$x\leq 0.08$ (acceptable) $x\leq 0.05$ (good fit)	0.02	Good fit
RMSEA 90% CI		(0.02, 0.07)	Good fit
p-Value	$x\geq 0.05$	0.00	

The factor loading and path coefficient of each of the unique feature factors on the overall project team communication ineffectiveness is contained in Table 4 and Figure 1. 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) (Hair *et al.*, 2013). According to Hair *et al.* (2013), this effect ranges from 0.00 to 1.00, with 1.00 suggesting an absolute predictive accuracy. It is further indicated that an R^2 value of 0.75, 0.50, 0.25, respectively, describes substantial, moderate or weak levels of predictive accuracy (Kline, 2005; Hair *et al.*, 2013, 2014). Iacobucci (2010), Hair *et al.* (2010, 2013) and Franke *et al.* (2008) 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 *Multiple Construction Sites & Management Style (MCS)* features of mass housing to project team communication ineffectiveness in relation to project-related information flow and composition, the results in Table 4 and Figure 1 indicate that MCS accounts for about 55% (0.552), and 53% (0.530) to information flow and information composition communication ineffectiveness, respectively, among the project team. This

Table 4 Factor loadings, *Z*-statistics, variance accounted for and reliability and construct validity of model testing (information flow and information composition)

Indicator variable	Standardized coefficient (λ)	*Z*-values	R^2	Path coefficient	Cronbach's alpha	Rho coefficient	Significant at 5% level?
MCS1	0.65	****	0.52	0.55 (0.53*)	0.73	0.82	Yes
MCS2	0.84	10.15	0.76				Yes
MCS4	0.69	7.66	0.61				Yes
MCS7	0.53	6.78	0.42				Yes
PCE2	0.72	****	0.56	0.704			Yes
PCE5	0.90	16.39	0.82				Yes
PCE6	0.87	11.44	0.78				Yes
PCE8	0.86	10.30	0.70				Yes
PCE16	0.94	24.61	0.85				Yes
PCE3	0.69	****	0.47	0.571			Yes
PCE7	0.80	20.30	0.65				Yes
PCE13	0.78	18.48	0.61				Yes
PCE14	0.80	20.30	0.65				Yes

* the path coefficient for the influence of MCS on Information Composition.
**** (MCS1=9.305) ((PCE2=9.916) PCE3=11.414).

could also be described as moderate effect (Kline, 2005; Byrne, 2006; Hair *et al.*, 2013, 2014). MCS7 (R^2 = 0.429) had the weakest contribution among these variables in the factor. From the R^2 coefficient of determination within the MCS indicator variables in Table 4, the direct contribution of the Multiple Construction Sites Management Style (MCS) factor (unique mass housing features) on the overall project team communication ineffectiveness in information flow and information composition could be described as statistically significant inherent in the degree of variances accounted for in each measure.

Analysis of the inner model suggests that MCS relatively has even effect (contribution) to information flow and information-composition-related communication ineffectiveness among the project team. Subsequently, the results of the 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. Likewise, it can be noted from the results that though information composition ineffectiveness among the project team from the influence of the unique *MCS* features indicated that *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 communication ineffectiveness among the team on mass housing. From this, results revealed that MCS2—*Site management style adopted on the housing units under scheme* and *MCS4—Change orders (Variation Orders) procedures adopted on repetitive housing units under scheme* make substantial contribution to MHP team communication ineffectiveness. The *MCS1—Contractor management style adopted on housing units under* scheme and *MCS7—Quality Management style and approach adopted on housing units and overall scheme(s)* on the other hand make moderate contribution to the overall communication ineffectiveness among the team.

Discussions

The results from the CFA presented in Table 4 revealed that multiple construction site management style features significantly contribute to the overall MHP team communication ineffectiveness with relatively similar effects in regard to information flow and project-related information composition. It was further noted that the variables *contractor management style adopted on housing units under scheme, site management style adopted on the housing units under scheme* and *change orders (Variation Orders) procedures adopted on repetitive housing units under scheme* were the main substantial contributors to the overall impact of the factor. The variable *Quality Management style and approach adopted on housing units and overall scheme(s)* was perceived to make moderate contribution to the level of communication ineffectiveness.

The results indicate that site management structure adopted on MHPs induce significant information-sharing-related communication ineffectiveness among the project team. According to Liu (2009), the site management organization structure is crucial in enhancing communication among the team as this defines the roles and the communication channels among the team. The PMI (2008) revealed that communication requirements and information needs of the project team is often related to the clarity in the roles and the site management set-up of the project organization. Xie (2002) revealed that poor site management structure often results in communication underload, overload and omission. The results generally agree with the general body of existing studies on the contribution of site management set-up adopted on projects in general. However, from a practical perspective, a plausible explanation to this finding is that, generally on MHPs in Ghana, there are poor site management set-ups lacking clearly defined roles in the project organization and teams. However, the uniqueness of the induced communication in this study is that, whereas notable studies indicated information overload, underload and gatekeeping as the main inherent communication challenges, here misunderstanding, untimeliness and distortions to shared information were the dominant challenges.

Construction projects which share multiple construction sites are characterized by large numbers of similar sub-projects undertaken regionally, nationally or globally as part of a single medium to long-term project and thus present managerial challenges in respect of requesting, sharing and documentation of project-related information and decision-making (Blismas *et al.*, 1999). The results indicated that *change orders (Variation Orders) procedures on repetitive housing units under scheme* of mass housing units being managed indicated that communication ineffectiveness among the team is substantially affected in both the information flow and information composition. The information management and documentation structure on construction projects often influence how and when change requests are made (Mead, 1999). Mead (1999) revealed that untimeliness, misunderstanding, procedure and distortions are curtailed when well defined, formal and regular request structures are adopted on construction projects. Fugar and Agyakwah-Baah (2010) revealed that delayed change request and related distortions have consistently been the basis of information-related disagreement and conflicts on Construction industry in Ghana. Hence, though arguably, MHPs are unique, the findings affirm and support the existing communication problems related to change requests in construction industry in Ghana. However, the emergence of this is not surprising. Drawing on the practical and theoretical perspective of site activities and organization of most MHP site, there are enough evidence of poor records management, and request (Fugar and Agyakwah-Baah, 2010). Practically, most change requests are often initiated by informal approach through verbal instructions. Even though this form of communication generally accepted in the industry in Ghana, the additional expected requirement for confirmation of the verbal instructions through a written format if often not done by both the project team and the contractor on the projects. Likewise, when this is finally done, it occurs at a later time when even the instruction has been carried out. Frequently, the situation arising from this is that the written confirmation instruction varies from the verbal instruction carried out leading to disagreement and consequently conflict among the team and parties.

Additionally, the *MCS1—Contractor management style adopted on housing units under* scheme and *MCS7—Quality Management style and approach adopted on housing units and overall scheme(s)* emerged to have moderate influence on communication effectiveness among the team. Liu (2009) and Xie (2002) revealed that misunderstanding, information distortions and inaccuracies were non-existent on construction projects I Hong Kong and China, respectively. Additionally, their studies further suggested that health and safety issues are well communicated and managed. Theoretically, the emergence of these findings is more likely not to be attributed to the uniqueness of MHPs. In the industry in Ghana, issues of health and safety are frequently reported as neglected on construction projects (Danso *et al.*, 2011). Likewise, there is seemingly acknowledged fact of most contractors and site supervisors engaged on construction projects lacking the requisite know-how and educational background to understand the primal contractor management techniques adopted on construction projects in Ghana. Hence, these results further reveal the unique characteristics of the project environment in Ghana compared to those of the developed countries.

Studying managerial effectiveness and site organization on MHPs, Enshassi (1997) indicated that the multiple site nature of mass housing schemes inherently affect the working programme adopted by the project teams across all the packaged housing. He further elaborated that this consequently affect the nature of information to be shared on efficient and economical method of carrying out the work, for continuous productive work for all the operatives employed, to facilitate organization, coordination and control of all tasks and activities across all the units and accuracy of information relating to material delivery on all units being managed by the team on all sites. Ahadzie *et al.* (2014) also hinted that the multiple site nature of MHPs being constructed have serious implications for communication among the project team as well as managerial inefficiencies that often results in productive time loss and documentation challenges. Hence, the implication of the findings is for project teams on mass housing to explore and develop management structures that adapt to and facilitate sharing of project-related information among the MHP team.

Conclusions

The issue of the contribution of the unique MHP to project team communication ineffectiveness has been a topical issue which is lacking empirical studies. Here the study was undertaken to bridge this knowledge gap by assessing the contribution of the unique management concepts and multiple site features of MHPs to project team communication ineffectiveness. The results from the SEM analysis yielded support for the hypothesis, indicating empirical evidence that the experience of MHP team communication ineffectiveness induced by the unique MCS features is relatively similar in both information flow and information composition among MHP teams. Conclusively, the overall results therefore suggest that the unique MCS features of MHPs considerably influence the project team communication ineffectiveness. The extent to which each variable in MCS feature contribute to the overall MHP team communication ineffectiveness has been explained. The contribution of the Multiple Construction Sites & Management Style (MCS) features to the overall project team communication ineffectiveness revealed that the MCS-induced communication ineffectiveness cannot be ignored and underestimated in the management and delivery of MHPs among the project team.

These findings lend support to the prevailing acknowledgement of the communication ineffectiveness inherent in the unique attributes of MHPs among the project team. It is thus very crucial for mass housing practitioners and stakeholders to pay particular attention to these findings towards developing communication strategies, planning, management and skills that adapt to the unique MHP environment towards ensuring effective communication among the project team. Additionally, it is very important for further studies to be conducted on the most effective communication media and the competency behaviours that best enhance the mass housing communication among the team in this project context in both encoding and decoding MHP information.

Disclosure

No potential conflict of interest was reported by the authors.

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Appendix

Communalities

S/no.	Description of variables in the multiple construction sites and management style (MCS) factor	Initial	Extraction
MCS1	Contractor management style adopted on housing units under scheme	1.000	.713
MCS2	Site management style adopted on the housing units under scheme	1.000	.898
MCS3	Construction technology and method adopted for repetitive works in housing units under scheme	1.000	.475*
MCS4	Change orders (variation orders) procedures adopted on repetitive housing units under scheme	1.000	.852
MCS5	Health and safety management techniques adopted for repetitive task construction works on housing units under scheme	1.000	.378*
MCS6	Computer application software(s) adopted by project teams on housing units under scheme	1.000	.448*
MCS7	Quality management style and approach adopted on housing units and overall scheme(s)	1.000	.988
Description of variables in the project team communication performance (PCE) factor (information flow)			
PCE3	Receiving less information than expected from team participants for tasks	1.000	.758

(*Continued*)

Appendix Continued.

Communalities			
S/no.	Description of variables in the multiple construction sites and management style (MCS) factor	Initial	Extraction
PCE7	Late delivery of needed communicated information	1.000	.638
PCE10	Receiving more information than necessary for the tasks	1.000	.422*
PCE12	Witholding of part of the information by the one who controls communication	1.000	.275*
PCE13	Difficulty in disseminating information among project team	1.000	.582
PCE14	Difficulty in accessing communicated information from channels	1.000	.717
PCE15	Witholding of whole of the information by the one who controls communication	1.000	.466*
Description of variables in the project team communication performance (PCE) factor (information composition)			
PCE1	Persistent change in content of communicated information	1.000	.451*
PCE2	Lack of consistency in communicated information leading to lack of coordination among project team	1.000	.651
PCE4	Persistent change in meaning of communicated information	1.000	.402*
PCE5	Receiving conflicting information from team participants	1.000	.678
PCE6	Lack of clarity in communicated information resulting in different interpretations	1.000	.585
PCE8	Misunderstanding of communicated information	1.000	.681
PCE9	Lack of conciseness in communicated information among the project team	1.000	.281*
PCE11	Lack of coherency in communicated information resulting in different interpretations	1.000	.430*
PCE16	Lack of defined roles and responsibilities among members of the team leading to communication failure	1.000	.733

Note: Extraction method: principal component analysis.
*Communalities less than 0.50 were dropped.