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An Empirical Study on Construction Process Corruption Susceptibility: A Vignette of International Expertise

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Abstract

Construction process stages are argued to be vulnerable to the prevalence of corrupt practices. However, the validity of this argument has not been empirically explored in the extant literature of construction management. Therefore, this study examines the stages of the construction process susceptibility to corruption and its most prominent forms of corrupt activities (within the respective stages). A total of forty-four project-related professionals were involved in an expert survey to assess such susceptibilities and the criticality of the identified corrupt activities at each stage. A comparative study of expert views from developing regions against experts from developed regions is conducted. Expert scoring results revealed that three stages are most susceptible, namely: project execution, pre-qualification and tender stages. Such results were confirmed by application of the Mann-Whitney U test statistics tool, showing wide disparities in seven out of eleven identical stages. This study is intended to incite polemic discussions and greater empirical, evidence-based research from scholars in both developed and developing countries. This study adds to the extant literature corruption-related works on the construction process through deeper understanding of the dynamic nature of corrupt practices involved in the stages of the construction process in developing countries. Practically, it intends to offer a veritable plethora of information on the critical stages of the construction process for industry practitioners, policymakers and anti-corruption bodies to careen their attention towards the fight against corruption.

Keywords: construction management; corruption; susceptibility; international survey.

Introduction

The construction process is reported to be a complex amalgamation of stages (Chan and Owusu 2017; Krishnan 2009). Firstly, beginning with the conception of a project, the process extends through to the realisation of that project and includes project maintenance and the resolution of any relational or contractual disputes that may transpire during the construction process or after project completion (Hendrickson and Au 2008). The construction industry is responsible for executing most of the tasks in the construction process. However, other auxiliary industry stakeholders, such as manufacturing and banking, as well as the judicial arm of most governments, play significant roles in the CP stages (Buswell 2007; Owusu et al. 2017; Yat et al. 2002). The complexity of the construction industry is evidenced by: i) the diverse plethora of professionals that make up a single project team; ii) necessary relational and contractual arrangements that bind them, and iii) the coordination they require throughout the project's construction process (Owusu et al. 2017). Though a diverse calibre of professionals are involved in a project (e.g., architects, engineers, contractors, quantity surveyors), significant emphasis regarding corruption is primarily placed on the contractor or the contracting team responsible for the construction and delivery of the project (Shan et al. 2017a; Sohail and Cavill 2008). Such emphasis on the contracting team can be attributed to their high level of responsibility and hence ability to potentially distort the process of a project with corruption (Shan et al. 2017a). Moreover, even though the complex contractual links among project parties are reported to be contributory factors to corruption, the attribution of corruption is more commonly directed to contractors and government officials (Le et al. 2014; Owusu et al. 2017).

Previously, the construction industry has been reported to be the most corrupt sector in the world (Krishnan 2010). However, a more recent report by Ivana Kottasova (2014) shows that the construction industry now comes second (behind the extraction sector) on the chart of the leading corrupt sectors globally. Corruption in this context is defined as the abuse of a project's resources, either public or private, for personal gain (Chan and Owusu 2017). To better understand the definition of corruption in the context of construction, it is necessary to identify the cultures of the industry and the influencing factors upon those cultures. Jian Zuo and George Zillante (2005) reported that the construction industry could be partitioned into two broad cultures, namely: project culture and organizational culture. However, a recent study by Emmanuel Owusu and colleagues (2017) indicates that the cultures of construction extend beyond the confines of project and organisational levels. The authors identified three additional important cultures, namely psychosocial, statutory and regulatory. The psychosocial construct deals with the mental, emotional, and social well-being of the stakeholders involved and the influencing environmental conditions on both the project and organizations. The statutory and regulatory cultures define the stipulated legal and institutional principles that regulate the other constructs (i.e., project, organizational, psychosocial) of the construction cultures (Owusu et al. 2017). The corruption risk-indicators or irregularities identified in these cultures influence the construction process negatively, and thus, distorts the entire process.

Moreover, as described later in this study, the construction process encompasses a number of different stages with myriad activities. As stated earlier, the process begins with the pre-construction activities (i.e., project conception, selection and planning), moving through to completion and maintenance, and resolution of conflict if any. A multitude of suppositions regarding the stage-related prevalence of corruption is found in the literature. For instance, reports from Transparency International (2006) and the Chartered Institute of Building (CIOB) (2013) reveal that the incidence of corrupt practices is most prevalent at the pre-construction stages. However, given the complexities in the definition of corruption in different cultures and domains, coupled with the complex nature of construction processes, there is a paucity of empirical studies examining how prone such stages actually are to corruption. This study, therefore, intends to investigate the likelihood of corruption at the various stages of the construction process with construction cultures (i.e., project, organisational, psychosocial) in mind. Theoretically, this study intends to contribute to the body of knowledge of corruption-related studies in the field of construction management and offers an in-depth understanding of the dynamic nature of the stages' susceptibility to corrupt practices. It also reveals the criticality of the different forms of corruption within the stages of the construction process. The findings from this study provide practical information to project parties, policymakers, researchers and anti-corruption advocates about identification and criticality of the key stages most prone to corruption. The study provides practical suggestions to aid development of more focused and stringent anti-corruption tools to eliminate the prevalence of corruption identified within the construction process.

Literature Review

Corruption is reported to be prevalent throughout the construction process but also occurs at all levels of stakeholder management (Ameyaw et al. 2017; Krishnan 2010; Shakantu 2006). The entire construction process commences at the *conception stage* – with a conceptualization of the facility to be built (Blackburn 2012). At this stage, the concept of constructing a facility to suit a particular functional utility is established. The client or the design team offer several concepts, of which one is selected to be developed. This leads to the project *selection stage*, which is considered the phase where all the possible projects' ideas conceived at the *conception stage* are examined. The client or the project team settle on the project with the highest advantage, score or priority. Therefore, at this stage, every item or listing toward the commencement and development of the project are often based on either proposals or suggestions, which help facilitate the selection of a suitable project to be constructed. This is done by taking into consideration the brief description of each project after careful and apropos deliberation of all the other proposed projects. Moreover, the foundation for conducting this activity (i.e., selecting one out of many) is based on the project feasibility and benefits (Hendrickson and Au 2008). Whereas the feasibility concept measures the probability that a project will be successful, the benefit concept measures the positive outcomes intended to be delivered by the project (Harris and McCaffer 2013; Pacific Invasive Initiative, PII 2011). The *selection stage* is of primary importance due to the prioritization of the numerous and diverse concepts developed at the *conception stage* which may sometimes exceed the budget of the financier. Parties involved in this process may range from the project manager to an agency management team (Levy 2010). Some scholars and industrial experts proffer that the selection stage is most prone to corrupt practice activities (Owusu et al. 2017). Catherine Stansbury and Neill Stansbury (2008) record a number of corrupt practice activities which frequently occur, or can readily occur, at this stage. For instance, selecting a project that is unnecessarily or overly-complex for the actual intended purpose, selecting a project to favour an unsuitable contractor, or predetermining a favourable contractor for a project intended to go through a competitive selection procedure.

Upon selection of the final project to be constructed, the construction process moves to the next phase, namely the *planning stage* (PII 2011). This stage involves the creation or development of drawing plans to guide the execution and completion of the proposed project. The *planning stage* delineates the *modus operandi* of each project team member by defining specific stakeholder responsibilities. Project planning is often facilitated by computer applications and tools such as the Gantt chart or Microsoft Office Project (Chudley and Greeno 2013; Wilson 2003). According to Ernest Ameyaw and colleagues (2017), portions of the project may be planned to favour some suppliers or contractors on the basis of relational attachments rather than necessary qualification. Moreover, as noted at the project *selection stage*, team members responsible for the planning process may incorporate redundant work items just to create room for exploitation of a project's resources during the project execution phase (Owusu et al. 2017; Sohail and Cavil 2008). The number of activities carried out at this stage of the construction process makes it vulnerable to corrupt practices, and according to Stansbury and Stansbury (2008), one primary form of corrupt practice identified at this stage is professional negligence. At the *design stage,* the project manager expands on the items planned in the preceding stage and details the organization, management, governance and design of the project. At this stage all project plans, specifications and requirements are integrated to develop a full-blown 3D model or 2D set of drawings (either paper-based or computerized), serving as a blueprint for the *execution phase* (Hendrickson and Au 2008). Corrupt practices often noted at the *design stage* include [but are not limited to]: i) exaggeration of a project's design and price to upsurge possible fraudulent remuneration during the project's execution; ii) manipulating the design of the project to favour specific contractors, suppliers and other team players; iii) giving facilitation payments to government officials for a satisfactory environmental impact endorsement; or iv) changing a project's timing (Brown and Loosemore 2015; Chan and Owusu 2017; Stansbury and Stansbury 2008). Aforementioned pre-contract activities tend to manipulate the process with favouritism, bribery and other forms of corrupt activities. While all these stages are identified to be vulnerable to corrupt practices, the situation is reported to be worse at the latter stages of the construction process. They are the *pre-qualification and tendering stage*, the *contract signing stage*, and the *project execution stage*. Some of the identified corrupt practices include: i) tender rigging, ii) price fixing, iii) obtaining a quotation only to compare price, and iv) submission of false quotations (Chan and Owusu 2017; Le et al. 2014; Owusu et al. 2017). Other prominent examples include: i) false or over-invoicing for the supply of either inferior materials or less equipment; ii) inflating claim amounts especially with regards to variation; iii) concealing defects; iv) giving a false assurance of contract payments to be made; and v) facilitation payments and other forms or acts of bribery to overlook substandard executed works (Owusu et al. 2017; Zhang et al. 2016). The *project execution stage* is where actual construction works are undertaken, or the plans and designs that were developed at the *conception/design stage* are undertaken, this stage being very vulnerable to high incidences of corrupt practices. The next critical stage is the *project maintenance stage*, where periodic checkups of the constructed condition or quality of an existing building are conducted to be compared against the required project brief and client requirements. This is done in order to correct any defects and keep the building in sound shape after completion (Hendrickson and Au 2008; Watts 2016). Building maintenance is therefore conducted from time to time to reveal any defects that may render the building unsafe or unhealthy to occupy. However, this stage is similarly prone to corrupt practices. Some, among many, of the noted examples at this stage include: i) dishonesty or overpriced procured items for the maintenance works; ii) executing substandard maintenance works; and iii) providing false quotations of purchased items. (Kenny 2009; Stansbury and Stansbury 2008). The last stage to be considered is the *dispute resolution stage* – evolving purely as a result of disagreement among contracting parties (Seifert 2005). Contractual or project disputes are not common to every project; however once they happen, they may contribute to the incidence of corruption. Some corrupt practices identified or likely to occur at this stage have previously been discussed in the literature; these corrupt practices include, among others: i) the submission of false supporting documents; ii) disproportionate billing by arbitrators or ruling parties; and iii) bribery of witnesses to provide false witness evidence or expert evidence. (Harmon 2003; Menkel-Meadow 1996). In addition, other thematic leitmotifs explored in literature on this subject include: i) different forms of corrupt practices prevalent at the different stages of the process; ii) common causes of the identified forms of corruption; iii) corruption risk indicators; iv) anti-corruption measures (ACMs) developed to eliminate the identified forms of corruption; and lastly, iv) barriers to effective implementation of ACMs (Bowen et al. 2012; Le et al. 2014; Krishnan 2009; Owusu et al. 2018b; Tabish and Jha 2011).

Richard Florida (2010) first pointed out in his article "*What Makes Countries Corrupt?*" that corruption does not necessarily happen in a vacuum. It takes corrupt parties to initiate the process of corruption. John Boyd and Jorge Padilla (2009) pointed out that there are three categories within which a corrupt party may fall, namely: i) demand party (one who calls for or initiates the corrupt process); ii) supply party (one who delivers or responds to the demands made by the demand side); and iii) condoning party (one who acts as a bystander with little to no care about the incidence of corruption). Thus, given that a corrupt case is identified in a specific project, the parties involved (i.e., contractors, government officials, suppliers) may fall under any or all the three categories mentioned. In a similar vein, although some factors may render projects more susceptible to corruption, the parties involved in a construction project are often unequivocally responsible for nurturing various forms of corruption alongside the associated causal factors (Owusu et al. 2017). In addition to bribery (the most frequent form of corruption) other common fraudulent practices include: collusion; patronage; ghosting; discriminatory practices such as cronyism, nepotism, favouritism; and extortionary practices such as clientelism, blackmail, and coercion (Brown and Loosemore 2015; Le et al. 2014; Sichombo et al. 2009; Willar et al. 2016), to name but a few reported from past studies. A comprehensive list of the noted forms of corruption in the construction industry has been reported in a recent review study conducted by Albert Chan and Emmanuel Owusu (2017).

However, according to Owusu and colleagues (2017), such forms of corruption crop up or evolve as a result of myriad causal factors, which include but are not limited to: statutory-specific, project-specific, regulatory-specific, psychosocial-specific and institutional specific causes. Resulting from fierce competition as seen during the tendering process, it has been reported that the construction process is doggedly corrupted by greed, substandard professional ethical conduct, government/political influences and overclose stakeholder relationships (Le et al., 2014a; Tabish and Jha 2011; Zhang et al.

2017). Lastly, scholars have recorded practical strategic mechanisms to expurgate corrupt practices in construction projects using frameworks and toolkits, namely by: raising public awareness about corruption, conducting stringent contract monitoring, performing rigorous supervision and auditing, and establishing a high standard accountability mechanism among several others (de Jong et al. 2009; Søreide 2002; Tabish and Jha 2012; Zou 2006). However, this study discusses the criticality of the various forms of corruption at the respective stages of the construction process as well as the susceptibility of these stages to corruption. As stated earlier, while some of the stages are reported to be susceptible to corrupt practices coupled with reports on varied views on the criticalities of the identified forms of corruption within the construction process, a systematic examination of the stages' susceptibilities to corruption and the criticalities of the various corruption forms in a unified view is presently lacking in the construction management-related literature. As such the development of the listed anti-corruption measures is not designed to focus on the weakness of a specific stage nor the intensity of a specific form at a specific stage. Simply put, most of these anti-corruption measures are generic. It is in reference to these gaps in literature that this study intends to examine the specific magnitudes of the stages' vulnerabilities to corruption as well as the criticality levels of the forms prevalent within the specific stages. This is arguably the first empirical study that focuses mainly on the assessment of the stages' vulnerability to corruption.

Research Methodology

Structured Survey

This study employed a questionnaire survey technique as the primary data collection approach to solicit the needed data from the experts. This technique has been widely used to solicit professional views on subjects within the domain of construction management-related research (Fellows and Liu 2015; Shan et al. 2017; Tan 2011). This study, therefore, used the questionnaire as the main data instrument to solicit the views of professionals involved in the construction process. This method was adopted as a means to reliably gather subject matter experts at a relatively inexpensive cost (Ameyaw et al. 2017; Hoxley 2008). The questionnaire was designed to gather the experts' views on the susceptibility of the construction stages to corruption as well as the critical forms of corruption prevalent at each stage. The questionnaire was structured in four primary sections. The first section presented the overall aim and objectives of the study and assurance of the respondents' anonymity and data confidentiality. The second section was designed to gather the background information from respondents including: i) professional affiliation, ii) working experience, and iii) geographical region. Section three solicited experts' views on the susceptibility of the construction phases to corruption using a five-point Likert rating scale (1= not vulnerable, 2=less vulnerable, 3=neutral, 4=vulnerable, 5=extremely vulnerable). Subsequent Likert scaling is predominantly adopted in CM research to facilitate the rating of relative importance of factors considered for a study that is based on expert views (Ameyaw and Chan 2015; Shan et al.2017). The fourth and final section sought to gather experts' opinions on the most pressing corruption form (CF) at the respective stages of the construction process using the constructs developed by Chan and Owusu (2017) (i.e., 1=bribery, 2=fraud, 3=collusion, 4=extortion and 5=discrimination). Prior to the expert survey, a pilot study was conducted to examine the rationality, appropriateness, technicality, comprehensiveness, relevance and language of the questionnaire. The questionnaire was reviewed by eight experts, comprised of five scholars (three professors and two senior lecturers) and three top-tier industrial experts from world-renowned institutions including the World Bank, the United Nations, and the Global Infrastructure Anti-Corruption Coalition (GIACC). The questionnaire was revised based on the comments received from experts to improve its language structure, understandability and appropriateness of questions. The revised questionnaire was disseminated to carefully selected experts (both academics and practitioners) via email (between May 2017 to November 2017). These experts were identified by contribution to the body of knowledge on corruption and involvement in the construction supply chain and other infrastructure projects. It can, therefore, be justified that purposive sampling (a non-probabilistic sampling technique) was adopted to select the respondents for the study. In order to encourage respondents' participation, the respondents were assured of their anonymity and confidentiality (Li et al. 2011; Owusu et al. 2018a). Over 300 questionnaires were distributed, with 62 retrieved responses. However, only 44 responses were deemed valid for further analysis due to the incomplete or unanswered questionnaires. The respondents range from 18 different countries with a 50/50 split between developed and developing countries (as shown in Fig.1).

Contextual sensitivity of the topic has rendered an unwillingness of some respondents in prior studies to fully disclose their opinion on the subject matter, leading to difficulty in obtaining a larger sample size of data (Ameyaw 2017; Brown and Loosemore 2015). Moreover, other potential respondents turned down requests to be involved in a study of this nature in order to protect their identity to prevent reprisal. Therefore, similar to the study of Ameyaw and colleagues (2017), this study stipulated some ethical measures to address any such concerns. The authors assured respondents that their identity was protected and that responses provided would be used solely for academic purposes and would also remain confidential. The ethical control procedures in place ensured a favourable sample size as compared with that of past studies; for instance, studies conducted by Ameyaw and colleagues (2017), Jeremy Brown and Martin Loosemore (2015) and Charles Vee and Martin Skitmore (2003) on the same subject of corruption in CM were based on 35, 23 and 31 responses, respectively, whereas the results of S. Z. S Tabish and Kumar Jha (2011) were based on six respondents. Therefore, the sample size obtained in this study was deemed adequate to extract significant findings. Moreover, even though the sample size remained relatively small, data analysis could still be carried out due to the fulfilment of the central limit theory of 30 responses (Chan et al. 2017; Hwang et al. 2015; Ott and Longnecker 2015). The profiles of the respondents are presented in table 2.

Data Analysis

Data Normality Test

Tae Kim (2015) indicated that many statistical tests require data to be normally distributed. This study, therefore, conducted the data normality test to identify the distribution pattern of the data. The Shapiro-Wilk test (SWT) was used to reveal the data distribution. SWT is commonly employed and recommended as an appropriate tool to determine the distribution pattern of any given dataset (Shan et al. 2017; Ott and Longnecker, 2015). The null hypothesis of the SWT states that “the population was normally distributed”. Therefore, if the alpha (α) value generated is less than the actual significance level (i.e., 0.05), a conclusion can be drawn that the dataset is non-normally distributed and subsequently the null hypothesis is rejected. Following similar corruption related studies as well as other CM based research such as Amos Darko and Albert Chan (2017) and Ming Shan and colleagues (2017), the actual significance level chosen was 0.05, and the test was conducted using SPSS statistics.

Determination of Cronbach's Alpha and Mean statistics

The data were analyzed using the SPSS v. 23 statistical package. Firstly, the data was statistically tested to determine the scale of reliability and credibility for the topic under investigation. The Cronbach's Alpha (CA) tool was employed to perform this operation. The CA method remains one of the most popular and widely used methods for measuring scales of reliability (Ameyaw and Chan 2015; Darko et al. 2018). It determines the internal consistency or average correlation among variables in a given questionnaire to examine the reliability of the questionnaire. The value of the CA coefficient (α) ranges from 0 to 1 and can be used to describe the reliability of variables deduced from questionnaires or dichotomous and multipoint structured scales (Chan et al. 2017; Santos 1999). The closer the value of α is to 1, the more reliable the adopted measurement scale. Simply put, a high α value indicates high reliability and vice versa. Jum Nunnally (1978) presented a rule of thumb for the threshold of the reliability index. According to the author, in order to justify the reliability of the scale adopted, the α value should be no less than 0.7. SPSS 23.0 statistical package was specifically employed to calculate the value of α for this dataset. The value obtained was 0.935 which indicated a very high degree of reliability. The dataset was therefore regarded as appropriate for further analysis (Chan et al. 2017).

Moreover, despite a relatively low number of responses, the experts were assigned to one of two groups based on their geographical and economic backgrounds (i.e., developed and developing countries). The alpha (α) values for both were estimated to be 0.961 and 0.788, which render the results from each expert group credible, reliable and valid for further discussions and analysis. These two categorizations were made to examine the proposition of the significant differences or disparities that exist between these two regions regarding corruption pervasiveness and control in the supply chain of the construction process.

To determine the relative importance or the level of vulnerability of each phase of the construction process to corruption, the mean score (MS) approach, which widely adopted in CM-based research and other corruption-related studies, was adopted to facilitate these estimations. The mean index for each stage revealed the degree of susceptibility for the respective stages of the construction process as well as the criticality of the corruption forms within the process. Moreover, in order to determine the relative importance of each phase of the construction process, the statistical t-test of the mean values was adopted at a test value of 3.5 against the significance level of 0.05.

Contextual comparisons

The Mann-Whitney U (MWU) test was adopted to examine the degree of relationship of variable rankings between two groups (i.e., developed and the developing countries) regarding the stages' susceptibility to corruption from the perspective of the experts' geographical context (Chan et al. 2009; Osei-Kyei et al. 2018). The essence of this test was to determine the significant differences between the two contexts regarding the stage's susceptibility to corruption. The MWU test was therefore regarded as suitable for measuring the significant difference between the two-independent group responses on a similar question (i.e., the degree of vulnerability each stage is to the incidence of corrupt practices). According to Patrick Lam and colleagues (2015), there is no requirement for prior postulation on the distribution of data during the application of this method. Moreover, the sample sizes of the groups involved can be varied or wide-ranging (Chan et al. 2017). The MWU test converts ratings provided by the respondents on individual variables to different ranks across the two groups involved (Owusu et al. 2018a). Subsequently, MWU reveals whether the ranks established by the two groups possess significant differences or not. In the application of MWU, the H_0 signifies that *'there is no significant difference in the variable ranks among the two groups.'* As a result, H_0 is rejected if the MWU value extends beyond its critical value at a significance level less than or equal to 0.05 ($p \leq 0.05$).

Table 4 presents the results obtained from the MWU test with the demonstration of the z values obtained for the vulnerability level of each of the eleven stages (i.e., C1-C11) with their respective p-values. For instance, the z value for project selection stage is -1.242 with a significance level of p=0.214. As presented in table 4, with the exception of the following stages (1) conception stage 'C1' (p=0.604), (2) project selection stage 'C2' (p=0.214), (3) planning stage 'C3' (p=0.368) and (4) design stage 'C5' (p=0.157), the p-values for all the remaining stages are less than 0.05. This means that other than these four stages as stated, the U test results for all the remaining stages show high significance, indicating statistically significant differences among the ranks of seven out of eleven stages as expressed by the two independent groups. The findings confirm the propositions stipulated from the literature on the differences between developing and developed countries regarding the pervasiveness of corruption and the measures for extirpating their incidence and effects in construction works. Moreover, these findings confirm that construction process stages in the developing context are highly vulnerable to corruption as distinct from the expert views held in more developed regions. That is, whereas experts from the developing countries agree on the high susceptibility of some of the stages to corruption, experts from the developed context share a collective view that all the stages are less vulnerable to the incidence of corrupt practices, even though their shared views do not suggest or stipulate an absolute absence of corrupt practices in the supply chain of construction works. These views are presented in figures 4 and 5.

Internal Consistency

The Chi-square test and Kendall's coefficient of concordance (w) are the two most frequently employed methods to examine the overall concurrence among ranking sets of non-normally distributed data (Lam et al. 2015). It is, therefore, appropriate to regard it as a non-parametric test. The Chi-square test was used to justify the respondents' levels of concordance since the number of critical variables examined was set to be more than seven (Wong et al. 2016). This study examined eleven critical stages. Regarding the application of the Chi-square test, the calculated Chi-square value was compared with the critical Chi-square distribution at the allowable significance level of 0.05 under the required degree of freedom (Df). The results are presented in Table 2. From the results, the level of significance satisfied the stipulated conditions. That is, referring to the values of the actual Chi-Square distribution table at the significance level (0.05) under the Df of 10, the actual Chi-square value is set at 18.307. However, the results indicate that the calculated Chi-square, which is 46.039, was greater than the critical stipulated value, 18.307 as presented in table 2. The results, therefore, confirm the common disposition amongst the views of the various experts on the suggested rankings of the stages' susceptibility to corruption.

Stage by stage comparison

Analogous to the study of Bon-Gang Hwang and colleagues (2017) and Ming Shan and colleagues (2017), this study conducted a detailed stage-by-stage comparison to identify the critical stages vulnerable to the incidence of corrupt practices as reported by the respondents. Two statistical techniques are often considered to perform the test based on the data distribution. They are the paired t-test (parametric test) and the Wilcoxon's signed rank test (non-parametric). Whereas the parametric test requires the data to be tested to be normally distributed, the alternative Wilcoxon's signed rank test is employed to compare matched variables with no assumptions of the nature of data distribution. Simply put there is no requirement for the data to be normally distributed (Shan et al. 2017). Therefore, due to the non-normally distributed nature of the data obtained in this study, the Wilcoxon's signed rank test was employed to perform the variable (stage-by-stage) comparisons.

[PLEASE, INSERT TABLE 1 HERE]

Survey Results

A total number of 44 responses were considered for further analysis. Many – over 85% -- of the responses came from researchers with past industrial experience, contractors and engineers. Over 60% of the respondents had more than 11 years of working experience or involvement in the construction supply chain. Coupled with such diverse backgrounds an overall high CA value of 0.935 was obtained, confirming the results as highly reliable and credible. The discussions are therefore made with respect to the two types of regions identified. However, since the respondents from the developed countries exceeded the responses obtained from the developing countries, it was considered that amalgamating the responses would potentially skew the results towards the responses from the developed context. Analysis and discussions are therefore made regarding the regions highlighted. Figure 1 represents the countries of the respondents involved in the expert survey. Even though an appreciable number of respondents happen to come from the developed regions (for example: Hong Kong and Australia), there is a relative level of consensus among all experts from both the developed and developing countries regarding the rankings of the stages as indicated by Kendall's coefficient of concordance (w) significance level and the corresponding Chi-square value.

[PLEASE, INSERT FIGURE 1 HERE]

Results and Discussions

Corruption prevalence and control

Broad consensus, in both the extant literature and institutional reports by World Bank, Transparency International (TI) and the United Nations among others points to the disparities of corruption control and pervasiveness of corrupt practices among developing and developed countries (Owusu et al. 2017). Whereas most developed countries are reported to have stringent and effective mechanisms to deal with corrupt practices and their attributes in various aspects, such is the opposite in developing countries. Moreover, while most of the common and easily accessible statistics on corruption (For example, the corruption perception index (CPI) by Transparency International (TI) and the Worldwide Governance Indicators on Corruption Control by the World Bank) capture a vignette of general views on corruption, industry-related statistics such as the pervasiveness and control of corruption of the construction sectors of the countries within these two regions (i.e., the developed and the developing countries) is lacking. This study, therefore, contributed to bridging the identified knowledge gap on the disparity between developing and developed countries with corruption within the construction process (See Figure 2).

[PLEASE, INSERT FIGURE 2 HERE]

The statistics presented in Fig. 2 form the basis for the discussions in the subsequent sections, as it indicates two divergent views on both constructs (i.e., corruption prevalence and control mechanisms) from the two classes of experts involved in the survey. While experts from the developed countries overall reported less prevalence of corrupt activities throughout the stages coupled with higher levels of control measures, experts of the developed countries have a dissimilar view in both constructs regarding corruption prevalence and control mechanisms. Table 3 presents the general overview of the responses from experts in both regions on the susceptibility of the stages to corruption and their respective scores. The table highlights the highly ranked stages in each case using the mean index ranking as well as the significant p-value for each respective stage.

[PLEASE, INSERT TABLE 2 HERE]

[PLEASE, INSERT TABLE 3 HERE]

Table 2 presents the mean statistic, standard deviations, significance level and the rank of each stage as expressed by the two different groups concerning their views on the susceptibility of the construction stages to corruption. The overall assessment of the responses was conducted to estimate the general view of the stages' susceptibility (found in the *overall scores column*). While the respondents from the developing countries expressed high vulnerability ratings for three out of eleven stages, the mean scores for the stages in the developed countries were relatively lower, indicating 'less vulnerable' for all the individual stages. Hence, such disparities in the results from the developed countries' respondents have greatly influenced the overall scales. Therefore, the overall mean scores indicate that circa half of the stages are deemed less vulnerable to corrupt practices while the other half indicate neutral points for the stages' susceptibility to corrupt practices. Overall, the experts indicated that the likelihood of susceptibility is in descending order in the following stages: project execution; prequalification stage; service delivery; and dispute resolution stages. An appreciable number of existing literatures regard these stages as the most vulnerable stages to corruption except for dispute resolution stage which is void of empirical justifications.

Individual responses from experts in developed countries demonstrated overall consensus that all stages are relatively less vulnerable to the incidence of corrupt practices. With the highest mean being 2.41, both the pre-qualification and tendering stages and project execution stage were identified to be most susceptible to the practices of corruption. Both had a similar mean score. Moreover, even though all the stages were identified to be less vulnerable to corruption, none of these stages was expressed to be completely devoid from corruption occurring at each stage. Figures 3 and 4 best illustrate this point, where respondents indicated the most pressing forms of corruption identified for each stage. Contrary to developing countries, results obtained from developed countries depicted high significance levels among all the variables (stages of the construction process) with the significant p-value of each stage less than or equal to 0.05. Conversely, upon further examination of results obtained from the developing countries, a number of divergences were identified in comparison to results from developed countries. Despite having identified that the mean values measuring levels of vulnerability were greater in developing countries, four out of the 11 distinct phases were regarded as significant. The project execution stage obtained the highest mean score as compared to the other stages of the construction process (i.e., 3.94 with a significant p-value of 0.001). Pre-qualification and tender stages followed with a mean score of 3.71, service delivery (score of 3.53) and dispute resolution stages (score of 3.53) were ranked fourth and fifth. Moreover, the stages regarded as significant with relatively lower mean scores were conception and planning stages.

Table 3 represents the Mann Whitney U (MWU) test as previously mentioned. As indicated in the MWU test results, there are significant disparities between developing countries and the developed countries regarding corruption pervasiveness and control. Whereas developed countries have stricter measures in place to control corruption, countries from the developing world are dogged by corruption despite the development and enforcement of innovative and pragmatic measures to tackle corruption (Owusu et al. 2017). Ineffectiveness of such control mechanisms often tends to create enough room for corrupt practices to thrive with ease throughout the process (Bowen et al. 2012; Tabish and Jha 2011). In table 3, considerable differences were identified in 7 out of 11 stages between the developing and the developed countries, capturing more than half of the entire stages. These include: i) inspection stage,

ii) pre-qualification and tender stage, iii) through to the dispute resolution stage. Moreover, such findings show that all the identified stages vary significantly regarding their levels of susceptibility to corruption. Simply put, the stages of developing countries are more plagued with corrupt practices as compared to that of the developed countries.

Lastly, the overall top three stages most susceptible to corruption are: i) the project execution stage (CP8), ii) the pre-qualification and tender stage (CP6), and iii) the service delivery stage (CP9). Results from the Wilcoxon's signed rank test (as presented in table 4) show that, comparatively, the assessment for CP8 was statistically higher than that for as many as seven other stages: project maintenance stage (CP10), contract signing stage (CP7), inspection stage (CP4), project selection stage (CP2), design stage (CP5), planning stage (CP3) and conception stage (CP1). The findings from this study support the observations alluded to by Tabish and Jha (2011) and Yun Le and colleagues (2014), project execution stage being quintessentially most susceptible to corruption.

[PLEASE, INSERT TABLE 4 HERE]

Assessment of CFs throughout the stages

Respondents were asked to identify the most pressing forms of corruption prevalent at each stage of the construction process. Adopting the constructs from the study of Chan and Owusu (2017), the constructs identified are bribery acts, fraudulent acts, collusive acts, discriminatory acts and extortionary acts. Using a rating scale of 0-5, where 0 represents extremely uncritical, 1= uncritical, 2 = somewhat uncritical, 3 = somewhat critical, 4 = critical and 5 = extremely critical, figures 3 and 4 present the CFs pervasiveness in each stage of the construction process of both the developed and the developing countries.

[PLEASE, INSERT FIGURE 3 HERE]

Results from the developed countries' respondents indicate that even though the phases of construction are less vulnerable to incidents of corruption, marginal levels of agreement were indicated on pervasiveness of the identified forms of corruption being prevalent throughout the stages with the exception of extortionary acts showing less prevalence. However, whereas some forms are highly prevalent at specific stages, others show a very minute degree of occurrence. The stage by stage analysis shown in figure 3 reflects the dynamic frequency of the incidence of corrupt practices within the construction process of the developed countries. Both project conception and project selection stages show the highest levels of bribery and collusive practices respectively, with project execution and maintenance demonstrating a high level of fraudulent practices. Discriminatory acts were identified to be prevalent at the design and prequalification stages, and even though extortionary acts were identified to have a low level of pervasiveness through the construction process, the highest score occurred at the project execution stage.

Moreover, there is a dominant and dogged persistence of bribery, collusion and fraudulent acts throughout the process unlike the case of the developing countries where almost all the stages were identified to be plagued by a high concentration of bribery acts. The leading three vulnerable stages are briefly elucidated in the following section regarding the most pressing forms of corruption exhibited. In the case of the developing countries' rankings, the leading vulnerable stages are the pre-qualification stage; tender stage; project execution stage and dispute resolution stage. This reemphasises the findings in the studies of Stansbury and Stansbury (2008), Tabish and Jha (2011) and Florence Ling and colleagues (2014) which have identified some examples of corrupt practices in both the pre-qualification and tender phase and the project execution phase. Interestingly, the frequently mentioned dispute resolution stage was one of the top three most susceptible stages to corruption. Though little existing research has addressed the issue of corruption at the dispute resolution stage, it seems likely that there is a need for more empirical research on corruption focussed on this stage of the process.

In both the project execution and dispute resolution phases, the most pressing forms of corrupt practices identified were fraudulent and collusive acts, respectively. Moreover, three different forms were identified at the pre-qualification and tender stages with the same score point: discriminatory, collusive and fraudulent practices. Remarkably, the most frequently mentioned form of corruption – bribery -- obtained a relatively low score at all three leading stages as expressed by the respondents from the developed countries. Moreover, the results imply that there is the need to address the other critical forms of corrupt practices (such as fraudulent and collusive acts) identified at the respective stages of the construction process. Future studies with a more specific focus in terms of context can contribute to deeper inquiry into such subjects. The summary of the CFs' criticality in both developed and developing countries' processes are presented in figures 2 and 3 respectively.

[PLEASE, INSERT FIGURE 4 HERE]

Unlike the findings of the developed countries, respondents from the developing countries indicated that the identified forms of corruption are not very prevalent at the project conception stage. Moreover, not all the forms are prevalent in all the stages. The respondents are of the view that the planning and dispute resolution stages of construction projects are less likely to be polluted with extortionary acts, and both design and pre-qualification and tender stages recorded no form of fraudulent practices. In addition, other stages such as project execution, maintenance and service delivery stages, recorded no forms of discriminatory and collusive acts. However, a sturdy rise of the slope representing bribery acts was recorded from the planning stage peaking at the project execution stage recording the highest level of corrupt acts. Moreover, at the pre-qualification stage, the bribery act construct was identified to be the most dominating form of corruption through to the dispute resolution stage.

Regarding stage by stage analysis, the critical stages identified by the respondents by their respective means include: project execution, pre-qualification and tender, service delivery and dispute resolution stages. The results present a common consensus that the project execution phase is the most susceptible of stages to corruption in the developing countries. The respondents similarly indicated that this stage records the highest form of bribery practices such as: kickbacks, solicitation, facilitation payments and lobbying (Chan and Owusu 2017). However, other CFs such as collusive, fraudulent and discriminatory practices recorded relatively lower scores and no scores with regards to extortionary acts at this stage. The results revealed CP6 (i.e., the pre-qualification and tender stage) as the second most vulnerable stage to corrupt practices. This follows a general consensus among the experts involved in the survey as this stage was identified to be the highest ranked stage by the respondents from the developed countries and the second highest by the respondents from the developing countries. Bribery acts similarly dominate this stage followed by collusive practice, and discriminatory and extortionary acts. While the construct of fraudulent acts recorded no score at this stage (i.e., the prequalification and tender stage), collusive practices such as cartels, price fixing and bid-rigging were identified to be prevalent at this stage of the construction process. Both service delivery and the dispute resolution stages also recorded bribery to be the most prevalent form of corruption with collusive and extortionary practices having no scores at the two phases respectively. However, the respondents agree that other forms of corrupt practices such as discriminatory and fraudulent practices are common at both stages. And lastly, whereas extortionary acts are common at the service delivery phase, collusive practices are also common at the dispute resolution phase as indicated by the respondents from the developing world. Lastly, the *dispute resolution stage* was identified by the respondents from the developing countries to be another key stage susceptible to the incidence of corrupt practices even though the opposite reflects the condition of the developed context. While this stage (i.e., the *dispute resolution stage*) is seldom examined in the domain of construction management research, the findings revealed this stage to be one of the vulnerable stages to corruption in the context of developing countries. According to Stansbury and Stansbury (2008), some of the noted practices include submission of false testimonial (witness evidence), exorbitant billing by arbitrators, umpires or lawyers, bribing or blackmailing witnesses among other forms. Not only do these noted examples contribute to the susceptibility of the *dispute resolution stage*, more recent examples of corrupt practices at this stage include over-manning and over-stretching of allocated time for dispute cases by lawyers or firms (Owusu et al. 2017). The mean index revealed this stage to be one of the susceptible stages to corrupt practices in the developing countries. Moreover, the MWU test confirms the wide disparities between the responses of the experts from the two contexts regarding the vulnerability of the dispute resolution stage (if any). There is, therefore, the need to develop specific and dynamic anti-corruption measures and frameworks targeted at dealing with the specificity and the criticality of CFs and their associated causal factors at the different stages of the construction process.

Limitations and Future Research

While this empirical study presents an overview of the stages' susceptibilities to corruption in both developed and developing countries, there were some drawbacks. The first limitation of the study is attributed to the non-generalization of the results. It must be emphasized that inasmuch as the results reflect the views of experts from developed and developing countries, they do not reflect the actual conditions of a specific country. For instance, the results cannot be taken out of context to represent the actual condition of the stages of the USA (for developed context) or Ghana (for developing context). This study is therefore conducted to serve as a foundation or a guide to facilitate the empirical exploration of similar studies in specific contexts. Context-specific studies (i.e., studies focused on a specific country) may generate a more reliable outcome as compared to the general views presented in this study. Also, the page and space limit would not allow for the discussion of individual countries involved. Authors, therefore, recommend that researchers (academic or industrial), from specific countries, investigate to identify the specific levels of the susceptibility of each of the stages regarding their countries.

In addition, five stages were identified as vulnerable for developing countries, albeit this may vary from country to country, and this is same for the case of the developed countries. The authors, therefore, suggest that future research studies be carried out in a more specific context, that is, country by country or institution by institution to identify vulnerability to corruption at the stages in the specific context that is being investigated. More specificity in such results can better inform the areas requiring immediate attention in the fight against corruption or much required anti-corruption measures. After the identification of vulnerable stages, more detailed research exploration can be made into the myriad constructs of corruption which include: i) identification of respective forms of corruption; ii) causes and risk indicators of corruption; and iii) barriers hindering effective development and application of anti-corruption measures. Three most vulnerable stages identified in the findings of both developing and developed countries were: i) pre-qualification and tender phase; ii) project execution phase, and iii) dispute resolution phase. Yet, dispute resolution stage has received a lack of attention regarding corruption control specifically in construction project management. There is the need to channel efforts to determine variants of corruption, causes and the risk indicators related to this specific phase to come up with needed anti-corruption measures to curb corruption at this stage.

Conclusion

This study presents empirical research on susceptibility of the stages to corruption as well as the prevalence of the corruption forms at these respective stages. The exploration and identification of the stages most susceptible to corruption are very useful not only for informational purposes but also for the development and implementation of pragmatic and strategic anti-corruption measures aimed at dealing with the prevalence of corruption in the construction supply chain. The study identified eleven distinct stages involved in the construction process. An international survey offers experts views from both developing and developed countries to determine the levels of vulnerability of each stage to the prevalence of corruption. Even though both contexts demonstrated less agreement on the pervasiveness of corruption, comparative difference lies in the number of stages which indicated high vulnerability in both developed and developing regions. That is, whereas all the stages of construction process in the developed countries are less vulnerable to corruption, some stages in the context of the developing world were regarded to be vulnerable to the incidence of corruption. Beginning with the stage with the highest mean values to the least, these four stages are project execution, pre-qualification and tendering, service delivery, and dispute resolution stage.

Moreover, the MWU test established significant differences in the rankings of the stages between the two expert groups. The results indicated significant difference among seven out of eleven stages, validating the differences of corruption prevalence and control in both the developed and the developing world. Also, in identifying the critical forms of corruption prevalent at each stage, the experts from the two regions reported significant levels of diversity on this question. Whereas bribery, collusion, and fraudulent practices were reported to commonly occur throughout the construction process in developed countries, bribery is seen to be the dominant form of corruption for developing countries. Lastly, even though the conception stages of both the developed and developing countries recorded either the least (or close to the least) levels of vulnerability, experts from the developed countries view that different forms of corruption -- especially bribery, collusion, fraudulent and discriminatory practices -- are the leading corruption forms when the project's requirements are defined. Since this study presented an empirical overview of the dynamic nature of corruption within the respective stages, authors recommend that future research be carried out in specific contexts (i.e. countries and institutions) to identify real case studies in different countries and institutions.

Conflict of interest

The authors confirm that the authors of this paper have no conflicts of interest.

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TABLES

Table 1: Respondents Profiles

Profiles	Categories	Number of respondents	Percentage
Background	Public Sector	32	72.7
	Private Sector	7	15.9
	Both	5	11.4
	Total	**44**	**100.0**
Professional Affiliation	Engineer	6	13.6
	Quantity Surveyor	4	9.1
	Contractor	13	29.5
	Architect	2	4.5
	Procurement Expert	1	2.3
	Researchers with industrial experience	18	40.9
	Total	**44**	**100.0**
Working Experience	1-5 years	9	20.5
	6-10 years	8	18.2
	11-20 years	13	29.5
	Above 20 years	14	31.8
	Total	**44**	**100.0**
Region	Developed country	27	61.4
	Developing Country	17	38.6
	Total	**44**	**100.0**

Table 2: Developing countries and the developed comparison

No	Construction Process	Code	Overall scores					Developing				Developed			
			Mean	Std. Dev	p-value	SWT	Rank	Mean	Std. Dev	p-value	Rank	Mean	Std. Dev	p-value	Rank
1	Conception	CP1	2.07	0.997	.000[a]	.000[b]	11	2.00	1.060	0.001[a]	11	2.11	0.97402	0.000[a]	10
2	Project selection stage	CP2	2.36	1.143	.000[a]	.000[b]	10	2.59	1.003	0.110	9	2.22	1.21950	0.003[a]	7
3	Planning stage	CP3	2.25	1.123	.000[a]	.000[b]	9	2.41	1.003	0.028[a]	10	2.15	1.19948	0.001[a]	8
4	Inspection stage	CP4	2.48	1.171	.000[a]	.000[b]	7	3.06	0.826	0.773	7	2.11	1.21950	0.001[a]	11
5	Design Stage	CP5	2.41	1.127	.000[a]	.000[b]	8	2.71	1.104	0.289	8	2.22	1.12090	0.001[a]	6
6	Pre-qualification and tender	CP6	2.91	1.394	.007[a]	.000[b]	2	3.71	1.159	0.023[a]	2	2.41	1.30853	0.026[a]	1
7	Contact signing stage	CP7	2.61	1.450	.000[a]	.000[b]	6	3.35	1.320	0.287	5	2.15	1.35032	0.003[a]	9
8	Project execution	CP8	3.00	1.414	.024[a]	.000[b]	1	3.94	0.966	0.001[a]	1	2.41	1.33760	0.030[a]	2
9	Service Delivery	CP9	2.82	1.334	.002[a]	.000[b]	3	3.53	1.124	0.070	3	2.37	1.27545	0.016[a]	4
10	Project Maintenance	CP10	2.65	1.274	.000[a]	.000[b]	5	3.18	1.131	0.529	6	2.33	1.27098	0.011[a]	5
11	Dispute resolution	CP11	2.82	1.40220	.002[a]	.000[b]	3	3.53	1.374	0.132	4	2.37	1.24493	0.014[a]	3

Note: [a] indicates data with significant results of one-sample t-test ($p < 0.05$).
[b] SWT represents Shapiro-Wilk test; SWT results indicates data were statistically significantly different from normal distribution
Cronbach's Alpha (overall) = 0.935; Developing = 0.788; Developed = 0.961; N = 44.
Kendall's W = 0.105; Asymp. Sig. of Kendall’s W = 0.000; df = 10; Actual calculated Chi-Square value= 46.039; Critical Chi-square value at p-value = 18.307.

Table 3: Mann-Whitney U test on the CP stages

Test statistics[a]	CP1	CP2	CP3	CP4	CP5	CP6	CP7	CP8	CP9	CP10	CP11
Mann-Whitney U	209.000	180.000	193.500	123.000	173.000	111.500	116.500	89.000	119.000	147.500	121.000
Wilcoxon W	362.000	558.000	571.500	501.000	551.000	489.500	494.500	467.000	497.000	525.500	499.000
Z	-.519	-1.242	-.901	-2.654	-1.416	-2.937	-2.810	-3.545	-2.755	-2.051	-2.680
Asymp. Sig. (2-tailed)	0.604	0.214	0.368	0.008[b]	0.157	0.003[b]	0.005[b]	0.000[b]	0.006[b]	0.040[b]	0.007[b]

a. Grouping Variable: Contextual groups (i.e., developed and developing countries)
b. Results indicating significant differences (Data with significant results)

Table 4: Significant test comparisons for the CP stages

Code	CP8	CP6	CP9	CP11	CP10	CP7	CP4	CP2	CP5	CP3	CP1
CP8	-	0.560	0.129	0.256	0.033 [a]	0.018 [a]	0.002 [a]	0.002 [a]	0.004 [a]	0.001 [a]	0.000 [a]
CP6		-	0.476	0.540	0.141	0.061	0.043 [a]	0.016 [a]	0.018 [a]	0.001 [a]	0.002 [a]
CP9			-	0.937	0.265	0.326	0.039 [a]	0.030 [a]	0.023 [a]	0.005 [a]	0.002 [a]
CP11				-	0.354	0.319	0.086	0.072	0.040 [a]	0.006 [a]	0.006[a]
CP10					-	0.867	0.319	0.095	0.146	0.021 [a]	0.008 [a]
CP7						-	0.473	0.119	0.303	0.066	0.017 [a]
CP4							-	0.442	0.557	0.190	0.035 [a]
CP2								-	0.802	0.509	0.083
CP5									-	0.256	0.066
CP3										-	0.298
CP1											-

Note: [a] Wilcoxon's signed rank test result is significant at p-value < .05, indicating that the stage-by-stage comparisons were statistically different

FIGURES

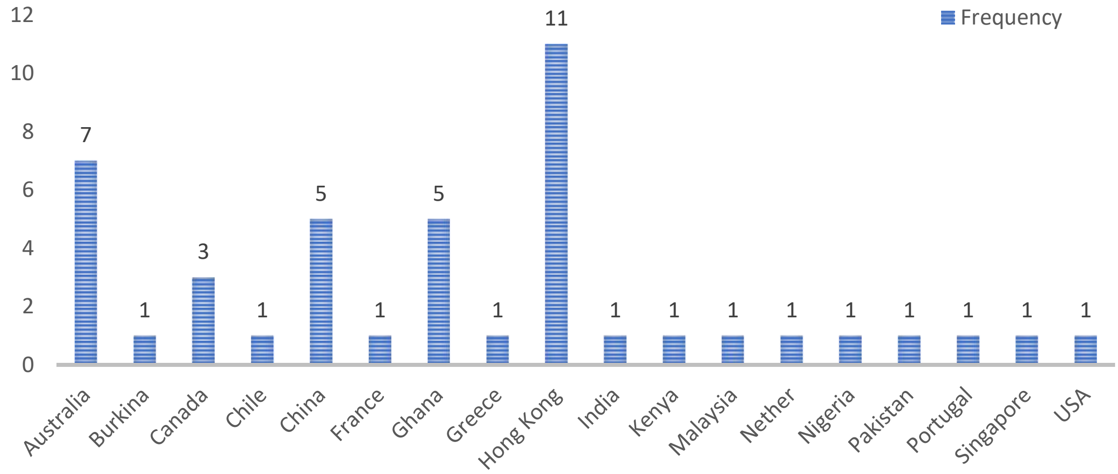
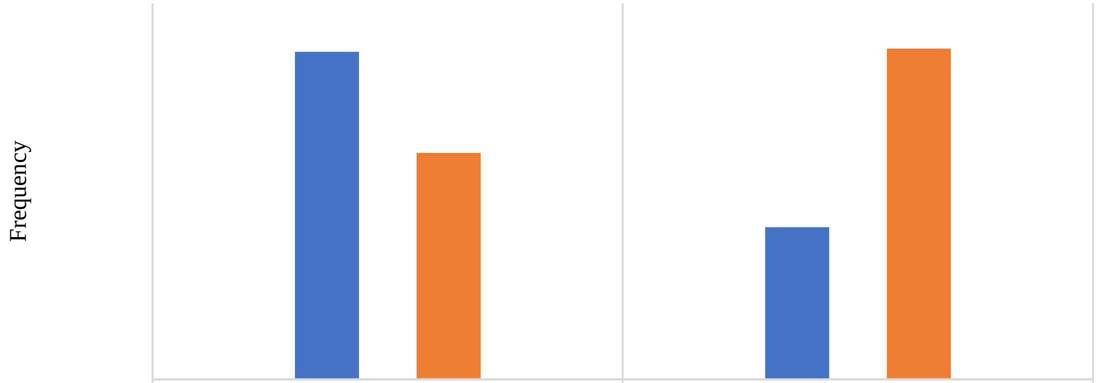


Figure 1: Countries of respondents



	Developing	Developed
Prevalence	3.92	1.82
Control	2.71	3.96

Figure 2: Graphical presentation of corruption prevalence and control for construction projects

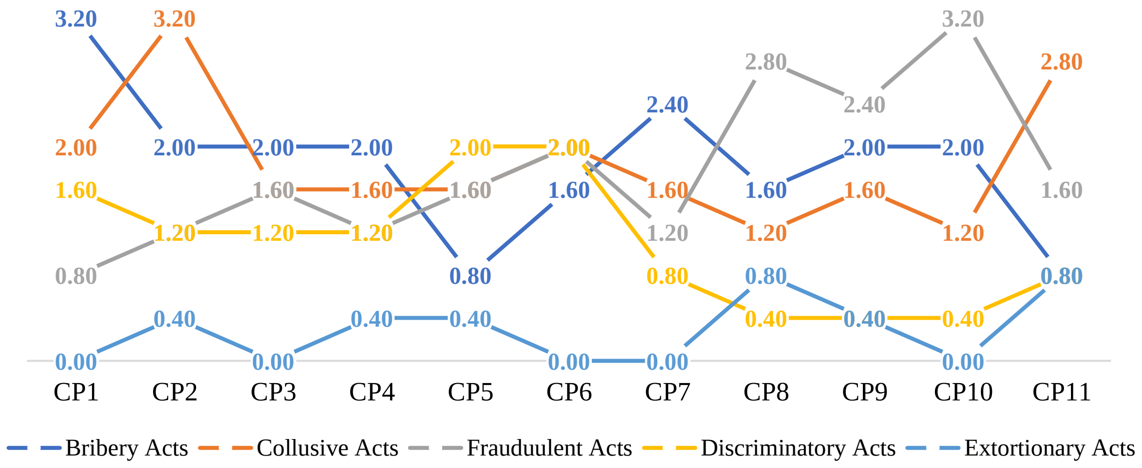


Figure 3: CFs prevalence throughout the construction process for developed countries

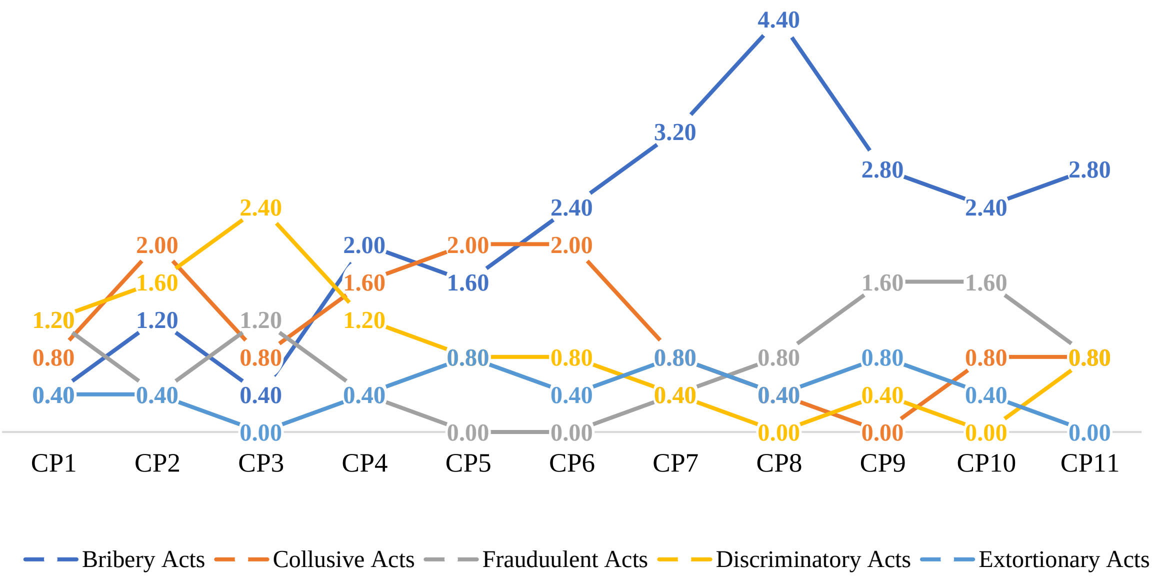


Figure 4: CFs prevalence throughout the construction process for developing countries