DYNAMIC EVALUATION OF CORRUPTION IN PUBLIC PROJECT PROCUREMENT: A COMPARATIVE STUDY OF EMERGING AND ESTABLISHED ECONOMIES.

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Dynamic Evaluation of Corruption in Public Project Procurement: A Comparative Study of Emerging and Established Economies.

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CERTIFICATE OF ORIGINALITY

I hereby declare that this thesis is my own work and that, to the best of my knowledge and belief, it reproduces no material previously published or written, nor material that has been accepted for the award of any other degree or diploma, except where due acknowledgment has been made in the text.

_____ (Signed)

Emmanuel Kingsford Owusu _____ (Name of Student)

DEDICATION

Salvator Mundi, **Iesus Christus.**

"Hi, Emmanuel,
"We just released our Corruption Perceptions Index 2018, and the results are troubling.
This year's index shows that the majority of countries are making little or no progress in ending corruption. Even worse, it reveals that the continued failure of most countries to significantly control corruption is contributing to a crisis in democracy around the world."

Transparency International, 2019.

ABSTRACT

The evolution and dynamism of corrupt practices have not only been tagged as one of the most critical socio-economic setbacks of governments and institutions but has also been identified to be one of the unending or cyclical phenomena globally. Public projects are not exempted from the effects of corruption. On the contrary, they are also greatly affected by the incident of corruption. Given that the industry responsible for executing public projects (i.e., the construction industry) is noted as the second most corrupt industry in the world coupled with the procurement process of projects identified as the most susceptible process to corruption globally. However, even though corruption is a global issue, the incidence, proliferation, and effects vary from context to context (i.e., from county to county and institutions to institutions). Anti-corruption advocates and researchers have extended both individual and collaborative efforts to explore the dynamism and effects of corruption over the past decades and centuries. However, analogous to a virus, the evolution of corruption never stops. Moreover, while efforts are being expended in the exploration of corruption in different fields such as sociology, criminology, business, among others, it forms one of the least research concerns for project management-related and construction management related scholars. As a result, even though corruption constitutes one of the topmost critical concerns in the project management and construction management-related domains, little attention has been devoted in this regard by related scholars, specifically in the developing context.

Against these backdrops, this research examines this long-standing socio-economic plague in public infrastructure projects holistically. Specifically, this research explores all prevailing constructs of corruption in public project planning, procurement, and management. Thus, this study investigates the various forms of corrupt practices and their associated causal factors of corruption in public infrastructure projects. It continues with the examination of procurement irregularities or risk indicators of corruption, anti-corruption measures (ACMs) developed and enforced to extirpate the proliferation and the effects of corruption, and lastly, the barriers that hamper the efficacy of the existing anti-corruption measures. This research employs diverse methodological tools and techniques to realize the

aim and objectives of this research. They include but not limited to descriptive statistics, fuzzy synthetic evaluation, social network analysis, among others. Data is gathered from both relevant literature and the experts identified through non-probabilistic sampling techniques.

The results indicate that the project procurement process in the developing context is susceptible to corruption. Although the negative constructs (causes of corruption, risk indicators, and the barriers that hamper the efficacy of ACMs) were revealed to have a significant impact on the procurement process, none of the anti-corruption measures was identified to be effective. Intensive efforts are needed to help address the issue of corruption in public projects, especially at the various stages of the procurement process. The models and framework developed in this research constitute proposed overarching measures to help address and extirpate corruption prevalent in public projects. The models developed are intended to help predict and evaluate the incidence and proliferation of corrupt practices throughout the different phases of the project procurement process with the sole aim to help fight corruption prevalent in public project procurement. Moreover, the overall framework developed is intended to inform project parties, anti-corruption activists, contract administrators and other relevant procurement-related experts about the dynamics and evolution of corrupt practices with their associated causal factors in projects and the specific efforts to extirpate their influence and effects throughout the most vulnerable process to corruption globally (i.e., the procurement process).

Keywords: Corruption; Forms of corruption causes; Vulnerability; Public projects; Infrastructure procurement; Developing and developed context; Ghana; Hong Kong.

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1. **Owusu, E. K.,** Chan, A., & Hosseini, M. R. (2020). Impacts of anti-corruption barriers on the efficacy of anti-corruption measures in infrastructure projects: Implications for sustainable development. *Journal of Cleaner Production,* 119078. (Impact Factor = 6.395)

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3. **Overall GPA** for course credits in partial requirements for the degree of Doctor of Philosophy = **4.0**

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AC	–	Anti-Corruption
ACET	–	The Global Anticorruption Education and Training Project
ACM	–	Anti-Corruption Measures
A-G	–	Attorney-General
AHP	–	Analytic Hierarchy Process
ASCE	–	American Society of Civil Engineers
CIECI	–	Construction Industry Ethics & Compliance Initiative
CIOB	–	The Chartered Institute of Building
CEM	–	Construction and Engineering Management
CM	–	Construction Management
COC	–	Code of Compliance
CoST	–	Construction Sector Transparency Initiative
CPI	–	Corruption Perception Index
DC	–	Design and Construct
DCEC	–	Directorate on Corruption and Economic Crime
FA	–	Factor Analysis
FCP	–	Fixed Price Contracting
FCR	–	Full-Cost Reimbursable
FIDIC	–	International Federation of Consulting Engineers
FSE	–	Fuzzy Synthetic Evaluation
GAS	–	Ghana Audit Service
GCI	–	Global Competitiveness Index
GDP	–	Gross Domestic Product
GFCF	–	Gross Fixed Capital Formation
GIACC	–	Global Infrastructure Anti-Corruption Centre
GMP	–	Guaranteed Maximum Price

GOG	–	Government of Ghana
HKSAR	–	Hong Kong Special Administrative Region
ICAC	–	Independent Commission Against Corruption
IP	–	Infrastructure Procurement
ISO	–	International Organization for Standardization
KMO	–	Kaiser-Meyer-Olkin
NACAP	–	National Anti-Corruption Action Plan
OCC	–	On-Call Contracting
OECD	–	Organization for Economic Co-operation and Development
OSC	–	Organizational-Specific Causes
PBC	–	Performance-Based Contracting
PCI	–	Procurement and Contractual Irregularities
PLS-SEM	–	Partial least squares path modeling
PPA	–	Public Procurement Act
PPB	–	Public Procurement Board
PPP	–	Public-Private Partnerships
PSC	–	Project-Specific Causes
PSSC	–	Psychosocial-Specific Causes
RSC	–	Regulatory-Specific Causes
SD	–	System Dynamics
SSC	–	Statutory-Specific Causes
TI	–	Transparency International
TPO	–	Total Package Options
UPADI	–	Union of Pan-American Engineering Societies
UN	–	United Nations
WEF	–	World Economic Forum
WFEO	–	World Federation of Engineering Organizations
WGI	–	Worldwide Governance Indicators

CHAPTER 1 – INTRODUCTION

1.1 Research Background

Many public and private enterprises globally regard corruption in Infrastructure Procurement (IP) as an inescapable fact of life. This is not uncommon in developing countries as corruption adversely influences the day-to-day modus operandi of the procurement of infrastructure projects, goods, and services. Corruption has had several definitions that vary across different norms, laws, and cultures (Jain, 2001). However, it is defined generically as the abuse of public office for private gain (Transparency International, 2016; Le et al., 2014; CIOB, 2013; Bowen et al., 2012; World Bank, 2003). The definition given above affirms the notion that corruption affects the public sector more than it does to the private sector, although private sector practitioners as well heavily influence the incidences of corrupt practices. This socio-economic scourge has evolved throughout the history of humanity and has been a global issue and a growing challenge for individuals, communities, societies, businesses, and the world at large.

Corruption connotes 5% an estimate of the total global economic output, which is approximately US $2.6 trillion annually (World Economic Forum, 2012; Osterman and Staudinger, 2008). Other negative impacts of corruption on the world economy identified included but not limited to: increased poverty, inhibited services provision, stifled investment, truncated economic growth and increased inequality (Gupta et al., 2002; Shakantu, 2006; Le et al., 2014; CIOB, 2013). In the developing world, it is widely admitted that corruption is a significant contributor to the truncated economy. According to the World Bank, corruption has been one of the utmost barriers to socio-economic development, which does not only result in misappropriation of resources but also, loss of lives and properties (Lewis, 2003). Corruption destabilizes development by weakening the economic foundations of institutions and distorting the rule of law (Tabish and Jha, 2011). The proliferation of corrupt practices in public infrastructure procurement globally has been intense, with the procurement process being regarded as the most vulnerable process to corruption.

Corruption, in public infrastructure procurement, can be defined as the use of entrusted power to the detriment of the infrastructure project or process for personal gain, (Transparency International, 2009). It is considered as the abuse of position, regulatory, legal, or political leverage to extract extra costs allocated to the procurement of infrastructural projects (Le et al., 2014). In this event, the project financier or developer may never recoup the loss incurred, and the perpetrators mostly deny their involvement thereof (Wang et al., 1999; Shan et al., 2016). Procurement of goods and services as well as investing in financial and public infrastructure in both developed and developing economies account for a substantial share of the budgets of states (World Bank, 2003; OECD, 2005; Mauro, 1995; Regan, 2008). OECD (2008) indicated that averagely, 17% of gross domestic product (GDP) represented gross fixed capital formation (GFCF) in developed countries and also in the range of 20% for developing countries. As a result, the misappropriation of funds allocated for infrastructure can pose a significant risk to the economy (World Bank, 2012). Walker (2003) purported that due to its nature of being capital intensive, most public practitioners in esteemed positions take advantage to exploit federal funds allocated for infrastructure for personal gain – corruption, which results in the distortion of the entire procurement process. This case is not uncommon in the developing world as excerpts of corrupt acts have been identified in almost every developing country (Hunga, 2003).

In most developing countries, existing literature and reports reveal how corruption has plagued the public sectors, which are also traceable in public projects. For instance, particularly in the case of Ghana, corruption has been noted as a critical impediment to the successful completion of vital public projects. For example, Ameyaw and Chan (2015) identified corruption as the second most critical risk indicator against public-private partnership (PPP) water projects in Ghana. A similar study conducted by Osei-Kyei and Chan (2017) also revealed corruption to be the leading risk indicator against PPP projects in Ghana. The list goes on and on as Damoah and Kumi (2018) recently reporting corruption to be one of the vital contributors to public project failure. The issue of corruption in the developing context, particularly in Ghana, has always been on the rise with limited efforts expended in exploring this menace can be tackled. Moreover, while some of the critical constructs of corruption in public projects such as the forms of corrupt practices with their causal factors, the risk indicators, anti-

corruption measures, and their associated barriers have been scantly explored, most of these efforts focus on the criticalities of the negative constructs of corruption such as the causes and the risk indicators. The explorations of these negative constructs are mostly conducted to reaffirm the notion or supposition that corruption is prevalent in the developing context.

However, in developed countries such as Singapore, the USA, UK and cities like Hong Kong, corruption in infrastructure procurement is somewhat checked and balanced by measures or systems such as e-procurement, raising awareness, rigorous technical auditing system, contract monitoring, comprehensive rules and regulations, education, access to information, stringent supervision among others (de Jong et al., 2009; Le et al. 2014; Tabish and Jha, 2012; Zou, 2006; Vaidya et al., 2006; Neupane et al., 2014). Particularly, Hong Kong, one of the world's finest cities, has gone a long way in dealing with corruption and has made tremendous efforts in their fight against corruption in infrastructure procurement (IP). The establishment of the Independent Commission Against Corruption (ICAC) in 1974 revealed that Hong Kong had experienced similar challenges of corruption in the past. However, the case has overturned with time (Yeung, 2000). Studies show that there is an apparent agreement among scholars that Hong Kong's ICAC stands to effectively transform its society in the direction of a corruption-free environment or records very minimal level of corruption as compared to its correlative agencies such as the ICAC of Korea (Quah, 2003; Bhargava and Bologaita, 2004; Choi, 2009). According to Rooke and Wiehem (1999), one of the brilliant, outstanding successes with regards to corruption combat in Hong Kong is the Airport Core Program. A report by TI (1999) indicated that this program outlines how corruption can be curtailed even in mega-size infrastructure projects. It is a typical exemplary success model in Hong Kong's infrastructure procurement.

This thesis, therefore, explores the principal concerns of the prevalence of corrupt practices observed in the public project procurement process in both the developed and the developing contexts using Ghana and Hong Kong as the representative scopes. Predominantly, it explores the forms of corruption, the factors that cause corruption, corruption risk indicators, anti-corruption measures and the barriers that hinder the effective adoption and application of anti-corruption measures in the public procurement

process. Models of the various constructs are developed to provide insights into the mentioned constructs of corruption. Moreover, an in-depth study on how the negative constructs (including the causes, risk indicators, and the barriers) can be dynamically tackled in all the stages involved in the procurement process are examined. The developed frameworks and checklist provided in this research may serve as a guide for industry practitioners, procurement entities, policymakers, anti-corruption institutions, decision-makers, and researchers. This is to facilitate the development of more strategic, advanced, and holistic anti-corruption measures potent enough to extirpate the proliferation of corrupt practices and resilient enough to resist the incidences and effects of the barriers that hamper the efficacy of anti-corruption measures. Consequently, such findings also contribute to the existing body of knowledge (BoK) on corruption-related studies in both construction and project management scholarships. The work also serves to provide a foundation for further empirical studies on the subject matter. The research questions, overall aim, and the objectives guiding the direction of the research are presented in the next section and **Fig. 1.1.**

1.2 Research Aim and Objectives

1.2.1 Research Questions

After thorough exploratory and preliminary review and following the background and problems aforementioned, the following questions are articulated based on the theoretical gaps identified:

1. What are the dominant forms of corrupt practices prevalent in the public IP sector and their causal instigators?
2. Are there any notable risk indicators (irregularities) within the IP process?
3. How effective are legal and institutional anti-corruption frameworks in their fight against corrupt practices and their mode of implementation? Are there any barriers that hamper their effectiveness?
4. To what extent are the stages of procurement vulnerable to the incidence of corruption?
    a. What are the adverse effects on each respective stage?

   b. What solution is best suitable to curb the incidence of corruption within the IP process?
5. What are the impacts of corruption constructs on the procurement process and how can they be mitigated?

1.2.2 Research Aim

The aim is to explore the dynamism of corruption in the public IP of developing and developed regions, using Ghana and Hong Kong to develop a dynamic framework to mitigate its prevalence.

1.2.3 Research Objectives

Thus, to provide relevant and appropriate responses to the stipulated research questions as well as realize the aim of the study, the following objectives are established:

1. Examine the forms of corruption and their respective causes that instigate or propel corruption in infrastructure procurement (IP);
2. Examine the procurement irregularities in the developing context;
3. Investigate the effectiveness and the barriers to effectiveness of the anti-corruption measures;
4. Examine the IP stages' susceptibilities to corruption, associated forms and respective strategic measures;
5. Develop a dynamic model to mitigate corrupt practices in the IP process.

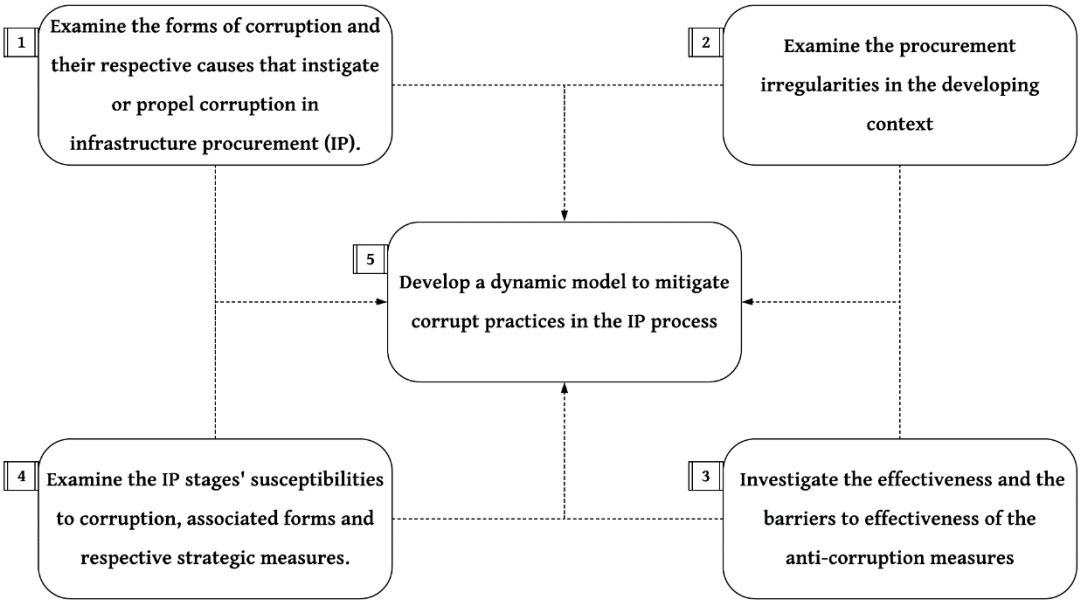


Figure 1.1 Interconnections of research objectives

Figure 1. 1 presents the relational interactions among the individual objectives of the study. The entire study commences with objective 1: where a thorough review of the forms of corruption is conducted together with the associated causal factors. An empirical assessment is performed on the constructs to ascertain the individual levels of criticalities of both the corruption forms and the associated causal factors. This cycle is repeated for objectives 2 and 3 to ascertain the criticalities of the identified procurement irregularities, the effectiveness of anti-corruption measures, and the criticalities of the barriers that hamper the effectiveness of the extant ACMs. In objective 4, a review and an empirical assessment will again be conducted on the various methods, stages, an activity of the procurement process to determine their vulnerabilities to corruption. Lastly, Chapter 5 culminates all the preceding chapters to measure the impacts of the corruption constructs that will be ascertained in objective 1-3 on the activities and stages of the procurement process in chapter 4 to determine the impacts of the constructs on the procurement process.

1.3 Research Focus

In a theoretical setting, this research focuses on the dynamic manifestations of the various forms of corruption in public project procurement. Particularly, this research focuses on the thematic constructs of corruption, which include forms of corruption and their causal factors, the procurement irregularities, ACMs, and associated barriers that hinder the efficacy of stipulated ACMs in public project procurement. Moreover, the evaluation of these constructs centers on the stages and activities within the procurement process. This is owed to the supposition that the procurement process is the most vulnerable globally, and also the construction industry responsible for executing infrastructure and other related projects is considered as the second most corrupt industry globally (Krishnan 2010; Kottasova 2014). As it is later discussed in the succeeding chapters, a series of comprehensive reviews are conducted to identify the principal variables underlying the mentioned constructs. Geographically, Ghana, and Hong Kong are selected for this comparative study.

1.4 Research Methodology

Research methodology refers to the comprehensive approach of the design process, commencing the theoretical underpinning to the gathering and analyzing of data (Collis and Hussey 2003; Thurairajah et al. 2006). This research employs the needed tools, techniques, and theories to help address the concerns of the study. This includes 1) the definition of the problem, identification of the relevant literature for the study. 2) framing of research questions, formulating the research aim and objectives. 3) Deciding on the technique that would be needed to gather the data and determining the tools required to analyze the gathered data and finally establishing answers to the detected problems (Brewer & Hunter, 2006; Sapsford & Jupp, 1998). To make a genuine contribution to knowledge, Kumar (1995) pinpointed the significance of reviewing previous methodologies. Reviewing earlier methodologies gives the researcher a complete understanding of both the past and present knowledge on the foundations of the employed methods. Wahab (1996) also, in his study, concurred with Kumar's (1995) findings.

The research approach adopted for this research is discussed in detail in chapter two. However, an ephemeral description, as well as the flowchart model of the research process, are illustrated in this section. As established, this research is limited to the examination of the various activities and stages involved in the processes of public project procurement, their levels of susceptibility to corruption, as well as the various constructs of corruption, explored in line with public project procurement. The plan of the study is made up of five stages described below:

Preliminary Phase: The preliminary stage comprises the initial research activities needed to establish the research questions, aim, objectives, and methods to realize the aim of the study. This stage of the study was achieved through the review of relevant existing literature, informal discussions with industrial and academic experts, and an adequate brainstorming session with the academic project supervisor as well as the project team.

Primary Phase: An apropos and a critical review of the various thematic constructs of corruption, which include the forms of corruption, causes of corruption, procurement irregularities or risk indicators of corruption, anti-corruption measures, and the barriers that impede the efficacy of anti-corruption measures. These reviews are intended to reveal the existing critical variables underpinning the mentioned constructs. The past and current trends and positions of both Ghana and Hong Kong on corruption were explored regarding global perspectives and rankings. Analytic considerations involved legislation, relevant literature review from articles, academic journals, textbooks, newsletters, and conference papers. Dialogues with pertinent practitioners in the construction and procurement sectors, anti-corruption institutions, and construction professionals as well as assessments of reports on corruption observed in Ghana and Hong Kong and related cases in infrastructure projects were also carried out.

Secondary Phase: The secondary phase includes the development of the study's questionnaire, a pilot test of the questionnaire, and an expert survey. Following the findings that were retrieved from the extensive literature reviews, a questionnaire was developed to solicit experts' opinions concerning the identified constructs. The questions, therefore, sought to identify the leading forms and causes of

corruption prevalent in the public procurement process, the criticalities of the causal factors of corruption and the risk indicators of corruption. Lastly, the effectiveness of existing anti-corruption measures and the criticalities of the barriers that impede the efficacy of anti-corruption measures were also examined. The questionnaire was developed and tested to suit the conditions of both the developed and the developing contexts. The questionnaire of Hong Kong was developed to enable a comparative analysis to be conducted to estimate the difference in performance and attitude towards corruption in both regions. Also, since the construct, 'barriers to the effective implementation and application of ACM is an unexplored area, particularly in the developing context, experts' interviews were conducted to solicit for rich data regarding this construct. The gathered data were analyzed to develop theoretical constructs for further testing and validation.

Advanced Stage: The advanced stage consists of statistical analysis and the development of the models. After the expert survey, the pertinent and pragmatic variables obtained were analyzed to establish the critical forms and causal factors that auger corrupt practices at the various stages of IP, the risk indicators, or procurement irregularities prevalent in the developing context, the barriers that affect the efficacy of the ACMs. A soft computing predictive model is developed to examine and predict the vulnerability of the procurement process. A model showing the significant relationships among the barriers impacts on the existing anti-corruption constructs is also developed to reveal the specific barriers that hinder the efficacy of existing ACMs. The network model is developed to reveal the impact of all the negative constructs of the various activities of the procurement process. Moreover, it aims to indicate the significant relationship between the variables under the negative constructs and the activities. Lastly, a comprehensive dynamic model is developed to illustrate how corruption within the procurement process can be extirpated. The various tools used to develop all the mentioned models are discussed in detail in the succeeding chapter.

Closing Phase: The closing phase succeeds the statistical analysis and the development of the models. A comprehensive review of the entire thesis is conducted to draw up the findings of the study and propose the needed action to be taken in both the short-term and the long-term run. Recommendations

for future research are provided in the conclusion section of the study. The flowchart model in **Fig. 1.2** below shows the overall research process of the study.

Figure 1.2 Flowchart of the entire study

1.5 Research Significance and Worth

Given the number of studies devoted to the assessment of the various constructs of corruption in public procurement, particularly in developing countries, not much has been done about the empirical assessment of how vulnerable the procurement process is to corruption. In essence, this is arguably the first study to conduct a holistic exploration of all the thematic or established constructs of corruption in public project procurement as well as the levels of susceptibility of the project procurement process. As a result, all the reviews conducted in this study contributes significantly to the scholarship of corruption-related studies in both construction management studies and project-management-related studies.

Theoretically, since previous studies have not empirically addressed the constructs of corruption explored in this research, the findings of this research represent the first to address all the primary constructs of corruption in public projects as well as the susceptibility levels of the different activities and stages of the procurement process. Consequently, this research contributes to the existing body of knowledge (BoK) on corruption-related studies in both construction management and project management-related scholarships. Moreover, this study provides a richer understanding of the dynamism and behavior of corrupt practices in the supply chain of the procurement process. Cumulatively, the research offers anti-corruption institutions, policymakers, and industry practitioners with the knowledge that may assist in the development and implementation of more effective anti-corruption tools. This research also serves as a foundation for further empirical studies on the subject matter to be conducted.

The relevance of this research is not only attributed to the identification of the barriers' criticalities that need extensive efforts in extirpating their influence but also the significant relationship that has been identified. In summary, regarding the theoretical contribution to the body of project management scholarship, this study reveals the relevant areas that need more effort during the development of ACMs for public projects. Moreover, not only are the constructs and the model developed original to the contribution of the BoK of project management, but also, this study's findings represent the first to

reveal the correlational impact of the barriers on the effectiveness of anti-corruption measures. Thus, making it arguably the first project management-related study to examine these constructs. Consequently, the outcome of this part of the study also contributes to the existing body of knowledge (BoK) on corruption-related studies in project management. It contributes to a deepened understanding of the constructs discussed in the context of project management in developing countries.

1.6 Structure of the Thesis

This thesis is composed of ten chapters, and they are detailed out as follows:

Chapter 1 – Introduction: Chapter 1 introduces the central theme of this research study. It stipulates the background of this study, an initial review to identify the research gaps, the problem statement, the research questions, aim, and objectives. Moreover, it presents the research focus encapsulating both the contextual and geographical scope, the research significance and worth, the plan, and methodology, also highlighting the approach used.

Chapter 2 – Research Methodology: Chapter 2 details the methodology that is adopted to realize the aim and the objectives of the research. It explicates all quantitative and qualitative methods employed throughout the entire process. They include pertinent literature review, structured interviews, descriptive analysis, content analysis, factor analysis, partial least squares structural equation modeling (PLS-SEM), fuzzy set theory, social network analysis, and system dynamics. The theory behind the adoption and application of these techniques to achieve the stipulated aim and the objectives would be explained in this chapter.

Chapter 3 – The Anatomy of Corruption: Chapter 3 consists of three sections, and they are discussed below:

Section 1 - The Evolution and Forms of Corruption: This chapter is set to detail out the intricacies of how corruption in public project procurement has progressed to its present stage. Through a careful analysis of relevant literature, section one explicates the anatomy of corruption, nature, all identified

forms and their causes or factors that give rise to corruption as well as the vulnerabilities, the cost of corruption to the individual, the society, the nation and the entire globe as a whole.

Section 2 – The Causal Instigators of Corruption: Analogous to section one, this section of Chapter 3 explores the leading causal factors that trigger the incidence of corrupt practices in project procurement. A pertinent literature review is conducted at this stage to identify these leading factors, which are tested empirically in both geographic regions considered in this study.

Section 3 –Anti-Corruption Measures and Associated Barriers: Attempts made to tackle corruption in public procurement normally exist either under statutory regulations or institutional mechanisms. This section of the thesis investigates the existing tools, measures, and frameworks established to combat corruption in public procurement. A thorough review is, therefore, made to identify the existing measures to fight corruption and anti-corruption measures. Moreover, even though institutions and governments develop strategic measures to curb the incidence of corruption. As to whether there exists a pragmatic, methodical process to access the effectiveness of these measures, literature is silent on it. This section addresses this issue by explicating the factors that serve as barriers to the effective application of anti-corruption measures.

Chapter 4 – Investigating the Cases of The Developing and The Developed: Chapter 4 explicates the cases of the developed and the developing contexts, respectively. Regarding the developing context, Ghana is selected as the specific scope of focus, and regarding the case of the developed world, Hong Kong is selected. Justifications for selecting both countries are discussed in this chapter, including their performances regarding the extirpation of corrupt practices within these two contexts. Analogous to the previous chapter, this chapter is also divided into sections. Section one conducts a thorough review of Ghana, whereas Section two focuses on Hong Kong. In the cases of both Hong Kong and Ghana, this chapter explores the underlying constructs of corruption on the general scale and in infrastructure procurement through a palpable review of relevant literature. In the case of Ghana, a deep review of relevant literature, as well as other related documents such as the reports of the Attorney-General (A-

G), is examined to identify the possible irregularities or indicators of corrupt behaviors in the area of procurement and contractual works. Aside from the investigations into the general thematic constructs of corruption, this chapter explores the vulnerabilities involved in the procurement of infrastructure works. A similar review is conducted in the case of Hong Kong. However, the aim of the Hong Kong review is mainly to investigate their best practices adopted for over these four to five decades. This

Chapter 5 – Conceptual Framework of Corruption in IP: This chapter presents the conceptual framework of a dynamic model for assessing corruption in the IP process. This section of the research thesis highlights the concept of procurement by clearly elucidating the complexities involved in the processes of public procurement and their relationship to corruption. Similar to the methods in chapter three, a detailed review was conducted to identify the systems, procedures, and policies involved in IP. The theoretical framework was developed to analyze the interconnections between the stages involved in procurement and their susceptibility or proneness to corruption. Simply put, how vulnerable each respective stage is to corruption is examined at this phase of the study.

Chapter 6 – Impact of Corruption on the Procurement Process

This chapter presents the empirical analysis of the negative constructs of corruption explored in this study and their overarching impacts on the various activities captured under the four respective stages of the procurement process. They include the causal factors of corruption, procurement irregularities, or the risk indicators of corruption within the procurement process and the barriers that hamper the effective application of anti-corruption measures. The individual criticalities of these negative constructs are conducted and presented separately within the various sections of this chapter. Moreover, this chapter concludes with the estimations of the overall significant impacts of the constructs on the various activities of the procurement process. Using the SNA technique, the developed model reveals that the overall impacts of the negative constructs of corruption on the procurement process are dynamic in nature as the criticality affect some activities more than others.

Chapter 7 – Examining the effectiveness of anti-corruption measures and associated barriers

Chapter 7 presents the empirical analysis of the efficacy of the established anti-corruptionn measures identified within the developing context. This reveals how potent the measures limit or extirpate the prevailing causal measures as well as the occurrence of corruption in the developing context using Ghana as the focus of study. Moreover, an effective evaluation index is developed using a soft computing technique known as the fuzzy synthetic evaluation (FSE). This is developed to help estimate and predict the effectiveness index of the measures stipulated to limit or extirpate corruption in the project process. Moreover, this chapter presents the criticality of the identified barriers that hamper the efficacy of the measures stipulated to curb corruption. With the application of the PLS technique, the significant relationships regarding the impacts of the susceptible against the measures are hypothesized and measured. Thus, the results reveal the significant paths that need critical attention.

Chapter 8 – Global Perspectives – Comparative Analysis and Exemplary Lessons

This chapter continues the empirical assessments from chapters 6 and 7 by comparing the generic results analyzed from the obtained from both the developing and the developed contexts. The chapter reveals the disparities in some of the critical constructs between the two contexts. That is, the justifications underlying the suppositions on why the developed contexts perform well when it comes to the matters of corruption as compared to some of the developing context. The chapter, therefore, reveals findings on some of the possible exemplary measures that most of the countries within the developing contexts can learn from the developed context. The lessons are aimed at reducing the impacts of the negative constructs and effects of corruption in public projects and the mechanisms needed to improve upon the efficacy of the ACMs.

Chapter 9 – Developing a Dynamic Framework for Checking Corruption

This chapter presents the dynamic model that encapsulates the constructs of all the thematic areas explored in this study. Unlike the previous chapters that focused on specific thematic areas such as the causal factors, anti-corruption measures, and barriers, among others, this chapter encapsulates all the constructs of the various chapters examined in this study. The dynamic model is developed to facilitate

the mitigation and extirpation of corrupt practices within the procurement process by limiting the impacts of the criticalities posed by the negative constructs of corruption as well improve the efficacy of the prevailing anti-corruption measures. Similar to the previous chapters, this chapter offers a comprehensive overview and contributions of corruption-related study to the body of project and construction management scholarships upon which further recommendations are made in the succeeding chapter.

Chapter 10 – Conclusions and Recommendations

Chapter 10 concludes this research. Inasmuch as the topic of corruption is noted to be an unending phenomenon, this research targeted to contribute to corruption-related studies within the domains of project management and construction management. The overall contributions of this research to infrastructure management related scholarships and practical implications to the industry are presented in the chapter. Lastly, the research limitations, in addition to the recommendations for future research, are presented in this chapter.

1.7 Chapter Summary

This chapter aimed to introduce this study and to present the background of the thesis. It presented both the theoretical and practical need for this research, the research question, the main aim, and the objectives this research intends to explore. It also introduces the key methods and tools adopted at the different stages of the study and presents a comprehensive flowchart diagram of the entire study. Lastly, this chapter highlighted both the thematic and geographical contexts of the study as well as the theoretical and practical contributions of this study to both the body of knowledge on corruption-related studies in project and construction management scholarships and the industry. The succeeding chapter specifically details out all the tools and methods selected for this study.

CHAPTER 2 – RESEARCH METHODOLOGY

2.1 Introduction

This chapter details the research methodology established to achieve the set aim and objectives of this research. This section discusses the methods for obtaining the required data, tools for analyzing gathered data as well as methods for developing the models proposed by this study. As suggested by Vogt (2007) and Steele (2000), to efficiently and accurately realize the research aim and objectives of a study and validate the findings, it is very expedient to adopt an apropos research methodology. Moreover, particularly to the field of construction management, Ameyaw (2014) and Walker (1997) mentioned that the right choice and application of rigorous enables CM based research projects to attain plausible results as well as contribute enormously to the body of knowledge and industrial practice. Past studies on corruption in the area of infrastructure procurement have seen the light of the adoption of wide-ranging methods to identify and explore the different topical constructs. Per the literature studied, the subject areas that have been predominantly explored include corruption forms and associated causal factors of corruption. Other include the risk factors or vulnerabilities associated with corruption, ACMs, and the barriers that prohibit the effective adoption and application of anti-corruption measures in the procurement process sectors (Shan, 2016; Le et al., 2014; Tabish and Jha, 2008; Soroide, 2002).

Some of the common research methods adopted in these studies include case studies, relevant literature review, questionnaire surveys and expert interviews (Bowen et al., 2012; de Jong et al., 2009; Boyd and Padilla, 2009; Zhang et al., 2016). Similarly, this study conducted a structured questionnaire survey and interviews with potential experts, and this served as the primary data for the study. Other auxiliary methods are adopted as appropriate. The tools employed for this study would, therefore, be used to investigate the constructs mentioned. Details with regards to the questionnaire development and survey are discussed later in section 2.5.2 of this chapter. The analysis of the collated data is conducted with the help of the following software packages: Statistical Package for Social Science (SPSS 23.0 for windows), Vensim Personal Learning Edition (PLE) for education and personal use (2016), Smart PLS

2.0 M3 and software recommended by experts. Most of the results are descriptively expressed in mean values, and the numerous variables identified in each topical coverage or context are grouped into a few important constructs with the help of factor analysis. The risk assessment of the variables identified under the vulnerabilities to corruption section is performed using the fuzzy synthetic evaluation method (Shan, 2015; Ameyaw, 2014). Moreover, the interrelationship between the causal factors of corruption, associated risk factors or vulnerabilities to corruption, the effectiveness of the prevailing anti-corruption measures, and the barriers to the application and the implementation of the anti-corruption measures are modeled using the SNA and the PLS-SEM. Lastly, the dynamism or the responsiveness of infrastructure procurement stages to the causal factors and the anti-corruption measures is modeled using system dynamics. The justifications underpinning the adoption and application of these techniques to achieve the stipulated aim, and the objectives are explained in the subsequent sections.

2.2 Research Design and Methods for the study

Pandey and Pandey (2015) defined a research design as the master plan or framework for a study, and it is used as a guide for gathering and analyzing data. Simply put, it is the blueprint for the entire research study (Kerlinger, 1971). According to Creswell (2003), a research design may be regarded as the logical and systematic sequence that addresses a topic under research, and per the study of Shan (2015) and Creswell (2003), the research design process embodies four distinct parameters for realizing the set aim and objectives behind a study. They include the questions behind the study, the appropriate data required to answer the questions, the methods of getting the data, and finally, the modes and techniques of analyzing and validating the data. A research design is also dependent on the researcher's personal experiences, the topic under the examination as well as the targeted audience that the researcher intends to reach. The formulation of excellent and comprehensive research design, therefore, intends to integrate the strategies mentioned above (Shan, 2015; Creswell, 2003). The entire research design process for this study is summarized in Table 2.1 and explicated into detail in the subsequent sections. Considering the research design as a general framework for achieving the targeted goals, the respective research methods are therefore proposed to undertake the procedures established in the design. Research

methods may include quantitative, qualitative, or mixed methods. Qualitative methods are predominantly employed to solicit for views in response to open-ended questions, and a researcher may employ techniques such as conducting an interview, focus groups, participant observation, etc. to collate or gather the needed data (Grbich, 2002; Patton, 2005; Shank, 2002). Quantitative methods, on the other hand, make use of instrument-based questions or what is usually regarded as close-ended questions to solicit for relevant data. Statistical analysis and interpretations are requirements for quantitative-based data, which is a direct contrast to that of qualitative methods. However, in the case of mixed methods, also known as methodological triangulation (Lee, 1991), both qualitative and quantitative methods are combined, and this allows the logic of triangulation, to enhance the validity of the findings (Bryman, 1992).

Based on the strengths of mixed methods stipulated from various studies, for instance, Bryman (1992), this study adopted the mixed methods approach to provide explicit and well-defined characteristics of corruption in public IP works in developing countries and, more specifically, in Ghana. Based on the study of Moffatt et al., (2006), Creswell (2014) and Lee (1991), the mixed methods or triangulation approach has been postulated as a more powerful and advantageous method than the single approach where a researcher either adopts the qualitative or the quantitative approach. A typical example that is often discussed in the literature is that researchers may adopt the qualitative approach to develop constructive theories and employ the quantitative approach to test the developed theories or vice versa. The entire design with the respective methods to reach each objective, as well as the aim of this study, are presented in Table 2.1.

Table 2.1: Research Process

RESEARCH OBJECTIVE	RESEARCH DESIGN (RD)											
	DATA COLLECTION					DATA ANALYSIS						
	LR	QS	EI	TA	CA	MS	FA	SEM	SNA	SD	MWU	FSE
1. Examine the forms of corrupt practices and their respective causes that auger the practices of corruption in public infrastructure procurement;	√			√	√							
2. Examine the procurement irregularities in the developing context	√	√	√	√	√	√	√					
3. Establish the stages in procurement and their susceptibility to corruption with respective strategic measures to curb its incidence	√	√			√	√		√			√	√
4. Investigate the effectiveness and the barriers to effectiveness of the anti-corruption measures	√	√				√					√	
5. Develop a dynamic overarching model to mitigate corrupt practices in public procurement						√	√	√	√	√		
Remarks	To establish a theoretical underpinning for the research	General survey which is also the first-round survey to solicit for expert views using questionnaires.	To verify the findings and developed models of the study	Qualitative technique that focuses on identifying, assessing and recording patterns in data	Adopted to make valid and replicable inferences by coding and interpreting textual material by evaluating texts systematically (eg. Reports, papers, graphics, etc.	Apropos for determining the significance of factors (Cheng and Li, 2002)	Used to express observed data values as a function of some possible causes to determine the most significant	An effective means for assessing relationships that exist among IVs and their effects on DVs	A methodical process of examining relational structures using series of networks and in a graph system characterized by edges, ties, and nodes.	A modeling tool to help understand complex problems and provides an approach for representing the dynamic relationships between variables in a system. (Chasey et al. 2002).	A non-parametric test to independent sample t-test employed to compare two sample means stemming from an analogous population.	A precise tool for handling complex and ill-defined fuzzy phenomena resulting from vague and incomplete data that characterize real-world problems

KEYS: LR – Literature review; QS – Questionnaire survey; EI – Expert Interviews; TA – Thematic Analysis; CA – Content Analysis; MS – Mean Score; FA – Factor Analysis; SEM – Structural Equation Modelling; SNA – Social Network Analysis; SD – System Dynamics; MWU – Mann-Whitney U Test; FSE – Fuzzy Synthetic Evaluation

The descriptive statistical tools were employed to ascertain the effectiveness levels of the anti-corruption measures and the criticalities of the negative constructs of corruption. The EFA tool was employed to identify the underlying relationships between measured variables and group them into identical constructs or latent variables, and the CFA was employed to examine how well the measured variables represent the number of constructs. The impacts of the constructs of corruption on the activities of the procurement process were ascertained using the network analysis tool. Lastly, the projected outcome of a less corrupt IP process coupled with effective ACMs were modeled using the SD tool. This was conducted to reveal the likelihood of how the impacts of corruption can be reduced and the ACMs enhanced in a given timeframe.

2.3 Methods of Data Collection

Following the suggestions by Jick (1979) and Fellows and Liu (2005), the choice of the appropriate research methods is usually influenced by considering the anticipated scope and depth. According to Ameyaw (2015), a questionnaire survey is a far-reaching study, a case study is a deep examination, and an interview falls in the middle of the two concerning the breadth and depth. A literature review provides enormous insight into the already available knowledge and practice. It as well highlights existing gaps in the literature. Tsai and Wen (2005) and Yi and Wang (2013) asserted that to properly review and analyze a relevant matter in academia, it is expedient that the researcher performs a thorough and systematic examination of previous works. Because this study examines the encompassing wide range of characteristics surrounding corruption in infrastructure procurement, primarily in developing countries, the selected methods of data acquisition are deemed relevant.

Furthermore, based on the exploratory nature of this study as well as the contextual and geographical scopes used in this study, the amalgamation of literature review, questionnaire, or field survey and experts' interviews is deemed appropriate. Therefore, while the experts' interviews intend to gather purely qualitative data, the questionnaire survey aims to collate quantitative data. This approach is known as the mixed methods approach or the methodological triangulation, which has been explicated

in the previous section. However, the mixed methods approach has been employed in this study to enhance the reliability and the validity of research findings (Akadiri, 2011; Creswell, 2014).

2.5.1. Literature Review

A literature review is a thorough and systematic examination of previous works by researchers (Tsai and Wen 2005; Yi and Wang 2013; Chow 2005). The entire study commenced with a comprehensive review of relevant previous materials from professional and academic journals, doctoral theses, and conference papers. Other documents include research reports (both published and unpublished), textbooks, and relevant information from the internet. These documents were consulted to retrieve every necessary information for the study and the background knowledge of corruption in public project procurement. The review of relevant literature enabled the gathering of both previous and current relevant background knowledge on corruption in both construction management research and the attributes of corruption associated with the procurement of public infrastructure. The literature review also formed the foundation for building a very firm theoretical base for the area of research aided in the establishment of the groundwork for realizing the aim and objectives of the study as well as addressing the research problems.

Moreover, the literature review was conducted to 1) establish the general theoretical framework of the study to help comprehend the topical constructs in this study; 2) understand the concept and evolution of corruption; 3) explicate the characteristics of corruption in the context of public IP and construction management as well as the geographical stance of corruption in developing context and the developed; 4) examine the causal factors and the forms of corruption in infrastructure procurement; 5) identify the parties are involved in carrying out the entire public procurement process; 6) understand the anti-corruption measures that have been developed and reported in past and current studies; 7) identify the barriers or constraint factors that hinder the effective adoption and application of anti-corruption measures; and 8) identify the possible methodological approaches for this study and lastly help in the development of the questionnaire and field survey.

This study performed six different reviews and are presented in three chapters. The first review, which represents Chapter 3 of this study reflected the evolution and forms of corruption in public infrastructure procurement from the standpoint of both the construction and procurement management research (Section 1). In Section 2 of Chapter 3, a thorough review of causal factors of corruption was conducted. Section 3 addressed the Anti-corruption measures (ACM) developed over the year to check and mitigate the incidences and practices of corruption during the process of infrastructure procurement. As an exemplary case study model, Chapter 4 reviews the stance of corruption in both Ghana and Hong Kong. Lastly, Chapter 5 presents the review of corruption in IP and the development of the theoretical framework.

2.5.2. Questionnaire Development

The data instrument used to solicit respondents' personal experiences and their views in this study were the questionnaire. This data collection method was adopted because it provides reliable and valid information within a manageable or relatively shorter time frame at a reasonable cost (Ameyaw et al. 2017; Hoxley 2008). The use of questionnaires often ensures respondents' anonymity and data confidentiality, especially on sensitive matters, such as unethical practices in the management of construction and engineering projects and corruption (Chan et al. 2018). Most of the variables encapsulated in the questionnaire were derived from the extensive literature review conducted prior to the survey and the remaining from the interviews conducted. The 5-point grading scale system was adopted in most of the cases, and the respondents were asked to grade the variables according to the modes of presentation.

A questionnaire was therefore developed after conducting the reviews on the various constructs of corruption in public projects (Causes, forms, ACM, Barriers to effective implementation and application of ACMs, etc.). The questionnaire was structured in three sections with fifteen questions. Section A entailed an explicit and understandable cover letter that introduces the survey. Section A

requests the personal data of the respondents. This section was constructed in two parts, Section A1 for construction experts and Section A2 for procurement experts. Section B encompassed five closed-ended questions on the subject matter, and Section C consists of 2 close-ended or statistical questions (focused on Ghana). All questions in Section B and C were generated after the comprehensive review of the germane literature on the subject matter and were verified by ten experts through a pilot test study. The first question of Section B asked the respondents to rate how the activities within each phase of the IP process as well as the construction processes are vulnerable to corruption and the associated forms. Respondents are also asked to rate how the parties or professionals involved are also vulnerable to the process mentioned above. Question 1B in Section B also sought to retrieve information on the type of procurement system that is very prone to corruption. Question 2 of the same section, requested information on the criticality of the identified CFs in IP using the linguistic ratings from 1 to 5.

Question 3 solicited the respondents' views on the effectiveness of anti-corruption measures, and Q4 sought to find out the criticality of the barriers that hinder the effectiveness of the ACM in IP. Lastly, Q5 of Section B was established to measure the pressing causal factors that trigger corruption in IP. This question required the potential respondents to rate how probable the identified variables are to occur and should in case they occur, how severe is the risk are to the procurement of infrastructure. This, therefore, represents the entire framework of the questionnaire to be distributed during the survey. However, in the case of Ghana, an additional section containing two more questions were included to develop a different questionnaire after identifying an appreciable number of corruption indicators noted in procurement and contractual works. Explications on how the factors were identified are provided in Chapter 4. Section one deals with the irregularities identified in procurement and contracts. The second section consist of recommendations suggested to help in dealing with the irregularities identified in both procurement and contracts. The final section requires respondents to share their views on how familiar they are with the legal interventions in the form of Acts, Legislation, and Policies against corruption stipulated by the Ghanaian government right from independence to date. They are as well required to rate their level of effectiveness base on how familiar they are with the stipulated interventions.

2.5.3. Ranking Scales

The ranking scales adopted in construction management research vary regarding odd numbers starting from five to eleven. This enables researchers to solicit for the views of respondents concerning an issue with several variables. The five-point Likert scale ranking system was adopted in formulating the questionnaire. Several CM based research works on corruption have adopted this system. For instance, Shan et al. (2016), Le et al. (2014), Bowen et al. (2012), etc. The five-point ranking system was employed on a number the bases, which included. They include: 1) the ease of presenting items and speedy administration, the ability to eliminate the problems common to ordinal measurement scale such as central tendency (Cronbach, 1951; Chan and Tam, 2000). 2) The provision of explicit diversities of probable opinions to the respondents that can facilitate the structural analysis (Pallant, 2005). Although this rating system is vulnerable to response bias, according to Revilla et al. (2013), the five-point categories provide quality data as compared to the other higher point systems such as 7 and 9. **Table 2.2** illustrates the scale definitions used in this study. The other ranking systems (e.g., 7-point and the 9-point ranking systems) are known to be complicated and has the potency of putting some respondents from responding to all the questions (Pitt et al. 2009).

Table 2.2: Ranking Scores Definitions

Ranking Scores (RS) Definition					
RS	PCPV	CF	ACM	BEA, CC, and CI	Forms
1	Not Vulnerable	Not Critical	Not Effective	Not Risky	Bribery Acts
2	Less Vulnerable	Less Critical	Less Effective	Less Risky	Fraudulent Acts
3	Neutral	Neutral	Neutral	Neutral	Collusive Acts
4	Vulnerable	Critical	Effective	Risky	Extortionary Acts
5	Highly Vulnerable	Very Critical	Very Effective	Very Risky	Discriminatory Acts

PCPV: Procurement and construction Process Vulnerability
CF: Corruption Forms
ACM: Anti-Corruption Measures
CC: Causes of corruption
CI: Risk Indicators/ irregularities
BEA: Barriers to the effective application of ACM

2.5.4. Questionnaire Pilot Study

After the initial development of the questionnaire, a pilot study was conducted to assess the entire comprehensiveness, relevance, and reliability before disseminating to the targeted respondents for their valuable responses. A total of eight experts from world-renowned institutions and academics were therefore selected based on their knowledge and experience in the subject matter, as revealed by their publications and their positions within their various institutions as well as their availability and willingness to respond to the survey (Shi et al., 2013; Potbhare et al., 2009; Chan et al., 2009). Specifically, they were consulted to examine the questionnaire's appositeness with regards to the lucidity of the questions, wordings, definitions, coherence, structure, and length, factors' relevance, the level of complexity as well as the use of technical terms (Oyedele, 2010; Ameyaw, 2015).

Per the feedbacks of the experts, the questionnaire was reviewed and thoroughly revised to enhance its quality and appropriateness, thus making it more suitable for the main survey. For instance, some experts suggested to reduce some of the factors, provide either a footnote or an appendix to define statements that may seem complex and ambiguous to the targeted respondents. In other instances, some of the factors were merged to form a single factor. An example is a provision of the appendix in the questionnaire to provide clear explanations of the various forms of corruption. These are just a few of many revisions that were suggested by the experts to improve the quality of the questionnaire in its present form.

2.5.4.1 Sampling Size and Sampling Technique

Sampling, according to Strydom et al. (2005) is simply the act of taking a part of the entire population to represent that exact population. Naoum (2008) stated that when considering a larger population, the percentage of the sample size needs to be smaller and vice versa, that is, if the entire population is smaller, the sample size should encompass a relatively larger proportion of the population. To attain an accurate conclusion and a more concrete prediction, the researcher should consider using a larger sample than a relatively smaller sample (Polit and Hungler, 1999).

Sampling is an essential and necessary aspect of any research study due to the constraint factors posed by cost and time (Altmann, 1971; Patton, 2005). Kothari (2004) emphasized that for a researcher to develop a suitable sample for the study, he must take into consideration the following building block: the demographical pattern for the study, the sampling unit, the source list, the sample size, parameters of interest, budgetary constraints and sampling procedure.

The sample selected for this study comprises of experts involved in the modus operandi of construction projects including planning, procurement, and management of projects. Categorically, they consist of professionals from the construction industry and the procurement sector of Ghana and Hong Kong. Although the concept of corruption may be regarded as a broad or general topic, only the experts who are involved in the procurement process were sampled out for both the questionnaire survey and experts' interviews. There is also no well-defined or comprehensive population to randomly draw out a sample from. Therefore, a random sampling approach cannot be adopted in this survey. In this situation, the best approach adopted was a non-probability sampling where the respondents targeted are selected based on their expert knowledge on the subject matter as well as their willingness to participate in the survey but not based on random selection (Sandelowski, 2000; Wilkins, 2011; Teddlie, 2007). The snowball and purposive sampling methods (i.e., non-probability sampling methods) were adopted. These techniques were used to identify the experts with adequate expertise and thorough knowledge on the subject matter. Although only one of these two approaches can be suitable for the entire research, the two sampling techniques were adopted to increase the sample size.

2.5.4.2 Purposive and Snowball sampling

Polit and Hungler (1999) delineate the purposive sampling technique to be a type of non-probability sampling technique, which involves the mindful selection of certain subjects to be included in the study. According to Bernard (2002), most types of research design compel the researcher to take decisions concerning the individual participants who would stand in a position to give the appropriate and needed data, in terms of both depth and relevance. This type of sampling technique was adopted based on the

research design, purpose, and practical implications of the study. In simple terms, the researcher agrees on what he needs to know, and seek to find people who are willing and can provide the needed information by their experience or knowledge (Lewis and Sheppard, 2006; Tongoco, 2007).

Teddlie (2007), explicates purposive sampling as a technique that involves the selection of certain cases or units, generally based on a specific purpose rather than randomization. Thus, a combination of multiple approaches was consulted to identify and retrieve a list of targeted public and private organizations potential respondents or departments within the targeted institutions. They included the direct request of information from the public institutions and industry organizations, internet publications, and related relevant information. After the generation of the list of potential institutions, invitation letters were officially sent to the senior managers and directors of the institutions to participate in the survey. They were also requested to nominate their top management staff with experience and knowledge in the IP process as well as corrupt incidents that pose threats to the processes. This process is aimed at helping solicit a potential list of expert individuals (Teddlie, 2007; Moglia et al., 2009). The potential respondents suggested at this level were also be invited and requested to participate in the survey.

On the flip side, the snowball sampling technique, the experts identified during the purposive sampling stage were resourcefully requested to share or help identify other potential experts with thorough knowledge on the subject matter. Therefore, in the quest to select suitable respondents at this level, the following criteria guided the selection: the respondent should possess deep and pragmatic working experience in the procurement of infrastructure works, and secondly, the potential respondent should be involved or up to date with contemporary procurement trends. The selection criteria were framed to consider respondents who were willing to participate in the survey and at the same time, accessible. A selection process prescribed above was strictly followed to invite suitable participants to take part in the survey. This was carried out to ensure reliability and the credibility of the responses. Also, since this study depended on the experience and knowledge of the experts, it was expedient to ensure first-rate standings of the potential experts as well as the robustness of the approaches of data collection.

Regarding the snowball sampling technique, the initially identified experts were opportunistically asked to share related information concerning other potential respondents (Moglia et al., 2009). Following criteria guided the choice of potential respondents recommended by their fellow practitioners:

- Have actively been involved in either research or policymaking concerning the subject matter (corruption) with regards to the construction and engineering sectors.
- Have robust practical or working experience in either the records or happenings of corrupt activities in the industry.

Since this study is skewed towards corruption-related studies in IP, there was a thoughtful effort ensure a very apropos representation of experts from different backgrounds who are actively involved in infrastructure procurement and the nature of corruption (Powell, 2003; Robinson 1991; Ameyaw, 2014). Therefore, the list of the potential participants consulted were made up of a wide range of professionals from the construction industry and public procurement institutions of Ghana, anti-corruption institutions in Ghana (NACAP, 2011) and academics or scholars who have expert knowledge on the subject matter.

2.6 DATA PROCESSING AND ANALYSIS

After gathering the study data, there is a need for data processing and analysis by the stipulated aim and objectives as well as the established purpose of the study at the initial stage of developing the framework of the research plan. The need for data processing and analysis is very vital for scientific study and also to ensure that every necessary and relevant data or information for conducting the anticipated comparisons and analysis is available. According to (Kothari, 2004), data processing refers to the practice of data editing, coding, categorization, and tabulation of the gathered data to make the data amenable to analysis. Analysis, on the other hand, refers to the computation or calculations or simulations of some measures together with searching for relational or correlational patterns that exist among the groups of gathered data. It relates to the ways by which answers are found through interpreting the gathered data (Strydom et al., 2005). Since explaining the raw data is either impossible or difficult, data description and analysis must first be done, and then the analysis results interpreted

(Strydom et al., 2005). The analysis here also means ordering, categorizing, summarizing, and manipulating data to obtain the solutions needed to answer research questions. The statistical methods employed for data analysis included a mix of both parametric (t-test) and non-parametric (such as mean score ranking, Factor analysis, Kruskal-Wallis one-way ANOVA test, Kendall's coefficient of concordance (W), Mann Whitney U Statistics) among others.

2.6.1. Mean Score (MS) Ranking Technique

The MS ranking technique has been recognized as one of the most important and critical tools employed by many researchers to determine the significance or the relative importance of individual factors to enable the easy identification of important factors. In most CM research papers on corruption, Le et al. (2014) used it to determine the significant causes and vulnerabilities that trigger the incidence of corruption in the Chinese Construction public sector. Bowen et al. (2015) also employed the MS ranking technique to assess corruption in the South African construction industry from the perspectives of construction professionals and clients. Several studies reviewed in this research study also employed the MS technique in addressing and determining various factors across diverse topics on the subject matter. The mean score is calculated using the formula below:

$$MSn = {5n_5 + 4n_4 + 3n_3 + 2n_2 + 1n_1}/{N} \qquad \text{Eqn. 2.1}$$

Where MSn = The MS for nth factor, n = respondents' scores based on a 5-point scale (from 1-5) and N= the total number of expert respondents. The MS ranking technique was therefore employed to rank the identified variables within their respective constructs.

2.6.2. Mann Whitney U (MWU) Statistics

The Mann-Whitney U test is conducted to analyze and identify the significant differentials that exist among the factors ranked by the respondents from the two different jurisdictions (Ghana and Hong Kong). Chan et al. (2011) emphasized that, as a nonparametric test, the Mann-Whitney U test is

employed to observe the relationship of ordinal data with two independent samples. The MWU test too is as well preferred for the following reasons as highlighted by Sheskin (2011): (1) unequal sample sizes of the two independent jurisdictions, that is, developing and developed contexts and also, the data set is not assumed to follow any distribution pattern. A predefined significance level of 0.05 is established for the MWU test to be performed. A significant perception between developing and developed contexts' respondents is highlighted to identify in the case where the p-value or the predefined significance level is less than 0.05 and vice versa situation.

2.6.3. Kendall's Coefficient of Concordance (W)

Kendall's Coefficient of Concordance (W) is primarily employed to measure the degree of agreement between the rankings or ratings by experts (Kendall and Gibbon, 1990). According to Schmidt (1997), it can also be employed to determine the level of consensus or any level of agreement among or within the ratings of a group and their relative consensus strength. The following advantages had extended the application of this tool. This method is reported by several studies to be easy and simple to use, the simplicity of tool application and interpretation, among others (Shi et al., 2013; Osei-Kyei and Chan, 2015; Lam et al., 2009). The degree or range of Kendall's W begins from 0 to 1, where 0 symbolizes no agreement, and 1 represents perfect agreement or concordance. According to Siegel and Castella (1988), the formula for Kendall's W computation is given below:

$$W=12\frac{\sum_{i=1}^{n}(R_n+\mathrm{R})}{p^2(n^3-n)-pT} \qquad \text{Eqn. 2.2}$$

Where *n* represents the number of factors, *Ri* represents the ratings assigned to the *i*th variable or factor; *R* denotes the *Ri* mean values; *p* signifies the number of respondents, and *T* stands for correction variable or factor for the tied ratings. Siegel and Castellan (1988) indicated that the applicability of Kendall's W test is only feasible and possible when the number of attributes or factors is below 7. The chi-square test value is therefore employed any time the number of attributes is greater than 7.

2.6.4. Risk Importance Index (Expected Value)

Some risk management scholars see risk as the likelihood that a risk variable or component (for instance disregard for public procurement act regulations, variations to contract or fragmentary procurement) happens paralleled with its severity to affect the entire IP or construction process. With this concept, IP risk is measured as a combined function of occurrence probability as well as severity, which can be estimated using this formula:

Risk = *f* (probability and severity) eqn. 2.3

Risk impact (probability × severity)$^{0.5}$ eqn. 2.4

This technique, also known as expected value, is a well-established approach to quantify risks in decision theory or calculate average risk (Tweeds, 1996; Carter et al., 1994). As a reliable approach to risk quantification and analysis, this technique has been adopted by several studies (Shen et al. 2001; Ameyaw, 2015; Chan et al., 2011). For instance, Ameyaw (2015) employed this technique to evaluate the importance of risk factors in PPP water supply projects in Ghana. In this study, this technique is employed to quantify the risk indicators of corruption in public IP.

2.6.5. Reliability Test

The reliability test measures the consistency in the data collected (Memon et al. 2011). There have been previous tools such as split-half reliability estimate and Kuder-Richardson estimate, which have been adopted in the past, and the latter still being used. However, the dominant reliability tool employed by many researchers today is the Cronbach also known as the coefficient alpha. Cronbach's Alpha is one of the most popular tools used to estimate the internal consistency reliability and assess the reliability and consistency of scales. It is used to determine the average internal consistency or the interrelations of variables in survey instruments to measure the reliability thereof. According to Santos (1999), the reliability of survey instruments and scales employed to gather responses from experts on a set of variables or factors is very vital for researchers to identify whether the factors in a survey instrument will continually yield stable and reliable results over a repeated number of times. The alpha coefficient is adopted in this study to examine whether the general statements and the variables within the various

constructs regarding corruption in infrastructure procurement in the questionnaire are reliable to measure the primary constructs, which this study intends to measure.

The Cronbach's alpha coefficient is designated by the symbol (α), and its value ranges from 0.00 to 1.00. The range values represent the lowest and highest respectively and have direct relationships with the degree of reliability. Meaning, the higher the value of α, the higher the scale's reliability (Cronbach, 1951; Santos, 1999). The reliability of the data set is considered low if the Cronbach's Alpha (α) coefficient is below 0.3, which makes the data unreliable. The reliability of the data set is, on the other hand, considered high if the α coefficient is above 0.7, which is also an indication of high internal consistency and, therefore, highly reliable and acceptable (Memon et al., 2011; Nunnally, 1978). According to Meeampol and Ogunlan (2006) also, a reliability coefficient of 0.5 to 0.6 range or more is very desirable and considered adequate for any form of analysis. According to Li (2003), the value of (α) is calculated using the formula below:

$$(\alpha) = \frac{k\ cov/var}{1+(k-1)cov/var} \qquad \text{Eqn. 2.5}$$

Where (α) = Cronbach's alpha coefficient, *k* represents the number of scale items; var = scale items average variance and cov = average covariance between scale items. Moreover, when there are standardization and common variance among the factors, the formula can be simplified, as shown below:

$(\alpha) = \frac{kr}{1+(k-1)r}$;

where *r* represents the average correlation among the scale items.

2.6.6. Factor Analysis

Factor analysis (FA) is a collection of methods used to examine how underlying constructs influence the responses on some measured variables and also with the goal of using a few hypothetical variables to represent a larger set of variables (Kim and Mueller, 1978; Chan et al., 2010). There are two types

of factor analysis: exploratory and confirmatory. Exploratory factor analysis (EFA) attempts to discover the nature of the constructs influencing a set of responses. Confirmatory factor analysis (CFA) tests whether a specified set of constructs is influencing responses in a predicted way. Factor analyses are performed by examining the pattern of correlations (or covariances) between the observed measures. Measures that are highly correlated (either positively or negatively) are likely influenced by the same factors, while different factors likely influence those that are relatively uncorrelated. It is commonly employed to examine the relationship among a given collection of observed variables and establish the probable variables capable of measuring or determining characteristics of the same underlying principles (Field, 2005; Hair et al., 1998; Norusis, 1993). In which case, the principal factors are developed out of the large number of variables that have been reduced to smaller components. The developed principal components can, therefore, be used to represent or explicate the entire data or intricate phenomena easily and adequately. As a result, FA has recently been one of the statistical tools developed to become widely accepted and commonly employed in construction management research (Ameyaw, 2015) as well as topics on corruption in construction (Le et al., 2014).

Moreover, the principal component factor analysis is deemed to be an apropos option among the various types of FA for data reduction (Yeung et al., 2010). With the stipulated strength of CPFA, this study employs CPFA to analyze and develop the fundamental groupings of the causes, risk indicators or vulnerabilities, anti-corruption measures, and barriers against the effective application of anticorruption measures in public infrastructure procurement. Also, the factor-solutions evolving from PCFA lay a very strong underpinning for additional complicated analysis, and this adds on to the significant merits possessed by PCFA. Chan et al. (2004) stipulate four necessary steps involved in carrying out FA. They include: (i) establishment the significant variables (e.g., Causes of corruption) involved in public infrastructure procurement, (ii) compute the correlational matrix for the variables, (iii) extract and rotate every component and lastly, (iv) name and interpret the principal components as the foundational constructs.

Before carrying out the FA process, a number of tests need to be performed to establish the suitability or appropriateness of FA for factor rotation. The tests include Kaiser-Meyer-Olkin (KMO) and Bartlett's

Test of Sphericity (Fox and Skitmore, 2007). Whereas the KMO measures the sample adequacy, Bartlett's Test of Sphericity is used to determine the existence of relationships among the variables, which aids in determining whether or not the correlation matrix of the population is an identity matrix (Hair et al., 1998). An appropriate dataset for factor analysis should have a p-value less than 0.05, which means that Bartlett's Test of Sphericity is significant, and KMO index should exceed 0.5. George and Mallery (999) asserted that these suggestions are widely accepted and adopted in construction management research.

2.6.6.1 Extractions and Rotation of Factors.

According to Nousis (1993), the extraction and rotation of factors are the two primary procedures involved in FA. The extraction of factors is essential to develop variables by factor solution (principal component analysis), whereas factor rotation is conducted to enhance how well to interpret the variables. Usually, the first factor-solution explicates the largest amount or degree of the sample variance, while the variance-explained that is remaining is shared across the other factor solutions. Varimax rotation, which is one of the most employed rotation methods in construction management research, is employed in this study to enable easy clarification and interconnections among the variables of both observed and latent variables (Oyedele, 2010; Chan et al., 2011). Moreover, with regards to Eigenvalues, which represent the sum of squared factor loading of the factors, which represents the degree of variance explained by a factor (Nousis, 1993). Based on the Kaiser criterion, this study retains only factors with eigenvalues greater than one.

2.6.7. PLS-SEM

According to (Shan et al., 2016), PLS combines the following techniques to simultaneously examine data and theory: principal component analysis, path analysis, and regression analysis. PLS is made up of two types of variables, namely observed variables, and latent variables. For observed variables, they can be measured directly, whereas latent variables are hypothetical or theoretical constructs that are inferred or contingent from observed variables. The results obtained from PLS are made up of inner

models, also known as structural models, and outer models also called measurement set. The measurement models examine the correlation among the observed variables, for example, causes of corruption and their associated latent variables (the formed constructs or underlying groupings of causes of corruption). The inner models or structural models assess the interconnections between the latent variables, which are examined. The PLS process is made up of multiple stages that involve three prominent or relevant steps, namely: specification of models; inner model evaluation; and outer model evaluation. In-depth explications have been made in the study of Hair et al. (2014). PLS-SEM is employed in this research to model the relationship between the causes of corruption and the risk factors, anti-corruption measures, and the barriers to the effective application of anti-corruption measures. In a more certain connotation, the technique is adopted to investigate the causal mappings between the causes of corruption and the indicators (vulnerabilities) to corruption in the Ghanaian public IP processes.

Moreover, as a multipurpose and multivariate analytical method in statistics, the PLS-SEM technique is used to simultaneously examine the relationships for correlational mappings among factors in a theoretical model (Le et al., 2014). This technique has become a very vital and common analytical technique in construction management research used to examine complete and emerging concepts and theories. The application of SEM in CM research has been successful because of these basic underpinnings: its potency to measure the cause and effect relationships among latent variables and it can also be used to examine the measured latent variables (Chan et al., 2010; Hair et al., 2012). There are two primary types of SEM, namely Covariance-Based SEM and Partial Least Squares SEM developed by (Chin, 1998). This study adopts the PLS techniques due to the following stipulations.

As compared to the covariant based SEM, the PLS possesses some advantages that have made it more successful in its adoption and use and has seen extensive improvement and use in various disciplines in recent times. According to (Afthanorhan 2013; Hair et al. 2011), some of the most protuberant justifications made by researchers who adopt the use of PLS are data distribution, the ability to use a small sample size and the use of formative indicators. Although this study does not anticipate a small sample size, PLS is still employed should in case a lower rate of the targeted respondents responds to

the questionnaire due to the sensitivity and nature of the topic. Reinartz et al. (2009) asserted that this technique is better adopted for a sample size that is relatively smaller and problematic for CB SEM to handle. This rationale also applies when highly complicated models are involved. These advantages have paved the way for PLS in recent years to be embraced and used extensively in construction management research (Le et al., 2014; Shan, 2015).

2.6.8.1 The application procedures of PLS-SEM

In conducting or using the PLS approach, these five procedures are usually followed. Examination of the data attributes, model specification and estimation, interpretation of the model, and lastly validation of the developed model.

2.6.8.2 Data attribute examination.

Stage one involves the examination of the sample size and data distribution. There is no need for distributional requirements in PLS-SEM due to its ability to handle very skewed or lopsided data distribution (Hair et al., 2012; Shan, 2015). As discussed earlier, this tool can realize very robust and accurate results even with a very small sample (Darko et al. 2017). The example with a small sample size of 20 was indicated by the Monte Carlo simulation outcome reported in the study of Chin and Newsted (1999).

2.6.8.3 Model Specification

At this stage, there is the building or development of measurement models as well as a structural model. Shan (2015) indicated that the development of the measurement and structural models are usually based on one's knowledge and experience in their respective fields being researched, theory review as well as literature review (Shan 2015, Aibinu and Al-Lawati, 2010).

2.6.8.4 Model Estimation

In stage 3, the estimation of the theoretical model parameters is conducted that is, the SEM analysis performs the parameters estimation for the relationships between the measurement items and their respective loadings, which are the latent variables and paths coefficient which represents the mappings between the various/different latent variables (Kline, 2010). However, since PLS-SEM takes every single latent variable as an approximate of its measurement items block. Therefore, the first phase of the estimation consists of iterative dimensions of simple and different regressions that is contingent on the specific model. This is conducted until there is an answer that converges on a set of weights used for calculating the latent variables scores (Shan, 2015). As soon as the outcomes for all the latent variables are achieved, the stages that follow consist of simple non-iterative applications of ordinary least squares regressions for obtaining mean scores, location parameters, path coefficients, and loadings for the measurement items and latent variables (Shan, 2015; Chin 1998). The fourth and last processes, namely *model evaluation and validation,* are explicated in chapter nine.

2.6.8. Fuzzy Set Theory (Fuzzy Synthetic Evaluation)[1]

The FSE technique is regarded as a branch of the fuzzy set theory developed by Zadeh (1965), which is often employed to quantify multi-attributes and multivariate (Osei-Kyei and Chan 2017; Hu et al. 2016). According to Ameyaw and Chan (2017) and Khatri et al. (2011), the FSE is a fuzzy multicriteria decision-making approach whereby individual factors of a construct are synthesized into a single score. Moreover, the opinions on the vulnerability levels of the procurement process by the experts are considered to be uncertain and typically subjective (Shan et al., 2015). Accordingly, FSE uses linguistic expressions (terms or variables) to represent and capture experiential knowledge of the survey respondents (Boussabaine, 2014), which helps to resolve uncertainty and subjectivity associated with the responses of the survey respondents (Ameyaw and Chan, 2015). The use of linguistic variables

[1]This section is fully or partially published in the following journal monograph: Owusu, E. K., Chan, A. P., & Ameyaw, E. (2019). Toward a cleaner project procurement: Evaluation of construction projects' vulnerability to corruption in developing countries. *Journal of Cleaner Production*, *216*, 394-407.

enables the respondents to qualitatively assess the vulnerability levels of the 21 procurement activities (Boussabaine 2014).

The FSE technique employs the application of membership degrees in a given set instead of a strict true or false membership (Tah and Carr, 2000). Simply put, rather than using absolute terms or values such as 0 and 1 to represent an elements association to a fuzzy set, the FSE tool expresses the element's belongingness to a fuzzy set in terms of varying degrees of relation. The degree or extent of membership can, therefore, consider any value within a closed range of 0 and 1 and the obtained value characterizes the degree or measure to which the element belongs to a fuzzy set (Ameyaw et al., 2015; Tar and Carr, 2000; Kasirolvalad et al., 2006).

The assessment of the overall vulnerability level of a project to corruption encapsulates the examination of the individual principal constructs of the procurement process (i.e., pre-contract stage, contract stage, contract administration stage and the post-contract stage) levels of vulnerability on one level and the activities within each construct or procurement stage on another level. A similar operation is performed on the principal constructs and variables of ACMs. In this instance, each primary component or construct is examined concerning its vulnerability level (in the case of the procurement process). This leads to the quantification of the overall vulnerability level of the procurement process. The multi-level fuzzy evaluation technique is often adopted to evaluate these multi-construct and multilevel challenges inherent in assessing a project's vulnerability to the incidence of corrupt practices.

Given that the determination of the susceptibility or vulnerability index of an infrastructure project is by nature fuzzy and often drawn on the subjective judgment of the experts, the FSE technique is deemed suitable (Boussabaine 2014; Ameyaw et al. 2015). This study also encapsulates three levels of vulnerabilities, which are: vulnerabilities associated with procurement activities (level 1), vulnerabilities associated with procurement stages of constructs (level 2), and the overall vulnerability associated with the entire procurement process (level 3). Inferring from these three levels, it is, therefore, apropos to employ the FSE technique to develop a vulnerability index and assessment model.

Lastly, The FSE technique was most preferable as it provides an objective index as compared to the ordinary weighting method. The steps for developing the vulnerability index are outlined below.

2.6.9.1 FSE Procedure

The FSE decision-making model comprises the following stages (Liu et al., 2013; Xu et al., 2010; Wei et al., 2010; Ameyaw, 2015):

1. Establishing a set of factors or basic criteria, $U= \{u_1, u_2, u_3 \ldots\ldots u_m\}$ *where* u_i *= (i=1,2,3,.....m)* represents the i^{th} factor estimation;

2. Create a set of grade substitutes which are detailed in linguistic terms for the variables $V= \{v_1, v_2, v_3 \ldots\ldots v_m\}$ *where* v_j *= (j=1,2,3,.....m)* represents the evaluation grade *j*. In simple terms, the grade substitute represents the employed measurement scale.

3. Create a set of weightings by evaluating the weight vectors of the evaluation variables as: $W= \{w_1, w_2, w_3 \ldots\ldots w_m\}$ *where* w_j *= (j=1,2,3,.....m)* signifies an evaluation factor I weighting and $(0 \leq w_j \leq 1)$;

4. Determination of a fuzzy evaluation matrix $R=(r_{ij})_{m \times n}$ where (r_{ij})expresses the degree to which an alternative $v_j$satisfy the basic criterion u_i in a fuzzy situation. The matrix of the fuzzy function R can be expressed as:

$$R=\begin{bmatrix} r_{11} & r_{12} \cdots & r_{1n} \\ r_{21} & r_{22} & r_{2n} \\ \vdots & \vdots & \vdots \\ r_{m1} & r_{m2} \cdots & r_{mm} \end{bmatrix}$$

5. Estimate the final results of the fuzzy evaluation by taking into consideration the weightings determined in step 3 and the matrix in step 4 using the equation given below:

$$\boldsymbol{D=W \bullet R=} (d_1, d_2, \ldots d_n) \qquad \textbf{(2.6)}$$

Where D stands for the final evaluation matrix; W=weighting vector; R= fuzzy evaluation matrix and ● represents the fuzzy composition operator.

Mathematical Functions of FSE

The effective application of the FSE technique demands the selection of an apropos function that passably analyses the contents (that is, membership functions and weightings) of the final evaluation matrix equation (see above, D). According to Lo (1999) and Lai and Hwang (1994), there are four primary functions of FSE.

$$M(\wedge, V), b_j = \bigvee_{i=1}^{m}(w_i \wedge r_{ij}) \forall\, b_j \in B \quad \textbf{(2.7)}$$

$$M(\bullet, V), b_j = \bigvee_{i=1}^{n}(w_i \times r_{ij}) \forall\, b_j \in B \quad \textbf{(2.8)}$$

The equations listed above (7.1 and 7.2) are regarded to be more applicable to single-items conditions due to their consideration of key attributes and ignore or disregard minor attributes. For instance, in assessing project risks, both equations are deemed unsuitable for processing the contents of Eq. D, because each attribute should have an effect on the whole index or level or risk.

$$M(\bullet, \oplus),\ b_j = min\,(1, \sum_{i=1}^{m} w_i r_{ij}) \forall\, b_j \in B \quad \textbf{(2.9)}$$

$$M(\wedge, +), b_j = \sum_{i=1}^{m}(w_i \wedge r_{ij}) \forall\, b_j \in B \quad \textbf{(2.10)}$$

According to Lo (1999), some of the data with leaser weightings are ignored by the min-operation in Eq. (2.10) and hence produces a similar output as in the cases of equations (2.7) and (2.8). The application of the FSE tool is demonstrated later in this study. More thorough explications regarding the adoption and application of the FSE technique are also presented later in the study.

2.6.9. System Dynamics

System dynamics, which was created during the mid-1950s by Professor Jay W. Forrester of the Massachusetts Institute of Technology, can be defined as "The investigation of the information-feedback characteristics of (managed) systems and the use of models for the design of the improved organizational form and guiding policy" (Forrester, 1961). It is a modeling methodology, which is employed to assist in the understanding of complex problems and provide an approach for representing the dynamic relationships between variables in a system. With a foundation of decision making, dynamic relationships, feedback analysis, and simulation, systems can be defined and modeled in a manner that allows experimentation in a laboratory setting (Chasey et al., 2002). System dynamics is

concerned with creating models or representations of real-world systems of all kinds and studying their dynamics (or behavior). In particular, it is concerned with improving (controlling) problematic system behavior. The purpose of applying system dynamics is to facilitate an understanding of the relationship between the behavior of a system over time and its underlying structure and decision rules (Wolstenholme, 2003). The system dynamics modeling technique (Sterman, 1992) can incorporate the causality links between the variables in a construction system and the activities involved in the production process. The model explicitly delineates and simulates the relationships between each variable mathematically. Once the system dynamics modeling technique identifies the critical factors, the chances of successfully implementing a set of fast-track activities can be greatly increased (Peña-Mora, and Li, 2001). SD is therefore regarded as a strategic methodology or approach that deals with the complexity - interrelationships and dynamics - of any social, economic, and managerial system (Yuan et al., 2012).

The application of SD has extensively been employed in various areas in construction management-related research over the last two decades, and this has revealed the extent to which SD application has been adopted to analyze complex issues in CMR. For instance, any complex social systems, particularly in industrial contexts, economic, social, and environmental systems of all kinds (Rodrigues and Bowers, 1996; Park 2005; Turek, 1995). The next section and diagram represent the processes involved in the application of SD. However, as indicated in other tools, further explication to the processes is presented later in this study.

2.6.10.1 Processes Involved in SD

- Conceptualization
- Define the purpose of the model
- Define the model boundary and identify key variables
- Describe the behavior or draw the reference modes of the key variables
- Diagram the basic mechanisms, the feedback loops, of the system formulation

- Convert feedback diagrams to level and rate equations
- Estimate and select parameter values
- Testing
    - Simulate the model and test the dynamic hypothesis
    - Test the model's assumptions
    - Test model behavior and sensitivity to perturbations
- Implementation
    - Test the model's response to different policies
    - Translate study insights to an accessible form

Following every single step within the four main themes under the SD process, this study employs SD to help understand of complex nature of corruption in IP processes and also provide an approach for representing the dynamic relationships between variables within the corruption constructs and the IP processes as well as the entire IP system as a whole.

2.6.10. Content Analysis

Content analysis refers to a set of both qualitative and quantitative techniques for gathering and examining data from electronic, print, and verbal communications with extensive applications in different fields of research ranging from education, construction to nutrition. Textual data from open-ended questions focus groups, and interviews can be analyzed using content analysis. However, the selection of methods is largely dependent on the length and type of data to be examined, technological capabilities, researcher's preferences, and the desired results (Kondracki et al., 2002). In the field of construction project management research, content analysis has been extensively employed to analyze textual information and data in both literature review studies and empirical research as well. For instance, Chan and Owusu (2017) employed this technique to assess and analyze papers selected for this section of the review study on forms of corruption in the construction industry.

2.6.11.1 Procedures and Applications

According to Mayring (2008), the qualitative content analysis process model can be broken down into four distinct phases. They are discussed below:

1. Material Collection: The material or data to be analyzed is determined, and the analysis unit is defined;
2. Descriptive analysis: At this level, there is an assessment of the features of materials/data. This provides a background for the following content analysis;
3. Category selection: Here, there is the selection of structural scoped as well as associated analytic categories which are needed to be applied to the gathered material;
4. Material Evaluation: the gathered materials are assessed based on their analytic scopes.

The divisions into different process phases or procedures are deemed very crucial aspects of qualitative content analysis because they allow inter-subjective verifiability and traceability, which makes it different from most or other hermeneutic or qualitative assessment techniques (Mayring, 2008; Duriau et al., 2007)

2.6.11.2 Validity and Reliability Issues of CA

Analogous to other analytical techniques, the overall aim of this technique (CA technique) is underlined by its validity and reliability issues. This is done to determine and record at least inter-subjective or relatively objective features of messages (Neuendorf, 2002). By this, if the outcome of CA is founded on multiple of different judgments of a sole researcher, then it is clear that the results are rather contestable. However, by including more than just a few numbers of researchers into the CA technique, reliability and validity of sampling (literature), as well as the analysis of the data, may be improved (Duriau et al., 2007; Neuendorf, 2002). Particularly, with regards to text analysis, one may differentiate the exploration for latent or explicit content. Whereas the former relies on the interpretations of researchers (mental schemes), indicating a pressing challenge, the latter can easily be assisted by software tools. As an apropos tool for analysis, CA was employed to analyze the literature review.

2.7 Chapter Summary

Chapter two detailed the methodology that is adapted to realize the success of this research. It explicated into detail all the quantitative and qualitative research methods that are employed throughout the research process. They include germane literature review, case study, structured interviews, descriptive analysis, social network analysis, factor analysis, partial least squares structural equation modeling, analytical hierarchy process, fuzzy set theory, and system dynamics. The theory behind the adoption and application of these techniques to achieve the stipulated aim and the objectives have been explained in this chapter.

CHAPTER 3 - A CONTEMPORARY REVIEW OF CORRUPTION[2]

3.1 Introduction

This chapter discusses the foundational constructs of corruption in the context of construction project procurement and management. As presented in the outline, the main themes include the different forms or manifestations of corruption and their causal factors, the contextual risk irregularities in the context of public project procurement. The remaining include anti-corruption tools and measures stipulated to extirpate or mitigate corruption and the barriers that hamper the effective application of anti-corruption measures. However, it must be emphasized that since all the different sections of the review followed an analogous and systematic technique of document retrieval and analysis, all the reviews were conducted independently based on the construct or the subtopic of corruption under review. For instance, the papers selected for the review of the forms of corruption were somewhat different from those selected for the causal factors of corruption and the ACMs. This section is, therefore, dedicated to the exploration of comprehensive reviews of all the identified constructs in the established order of presentation.

3.2 Forms of Corruption

Past studies have identified various forms of corruption in the industry (Dorée 2004; Brown and Loosemore 2015; Bowen et al. 2012; Le et al. 2014; Olawale and Sun 2013; TI 2016). The construction industry has been identified as the most corrupt sector, and the procurement sector is also branded to be the most vulnerable sector to the incidence of corrupt activities (TI 2005; Krishnan 2010). A report issued by the Organization for Economic Co-operation and Development (OECD) (2014) revealed that corruption had been deemed as one of the primary barriers to sustainable socio-economic and political development in developed, developing, and emerging economies alike. In all, corruption increases

[2] This chapter is fully or partially published in the following journal article: Chan, A. P., & Owusu, E. K. (2017). Corruption forms in the construction industry: Literature review. Journal of Construction Engineering and Management, 143(8), 04017057.

inequality, reduces efficiency, and is estimated to account for over $2.6 trillion annually, which is approximated to be 5% of the global gross domestic product (GDP) with over $1 trillion expended in bribes annually. Bribery has been revealed to be the most mentioned form of corruption in the industry as it is discussed later in this section. Most recognized anti-corruption frameworks are designed to deal with bribery cases. One typical example recently developed is the ISO 37001 anti-bribery management systems by the International Organization for Standardization (ISO) (2016). Noonan (1984) opined that the first case of corruption ever recorded was in the form of bribery, which occurred around 3000 BC. Bribery has therefore been regarded as the primary form of corruption that exists to date. However, because of the evolution of corruption over the years, different forms of corrupt practices have emerged, and more money is being expended in these newly generated forms.

The continual research on corruption over the last two decades has revealed varying forms of corruption in the studies available, but there is no literature to date that presents a comprehensive review of the forms of corruption prevalent in the context of the construction, engineering, and the procurement sectors. Therefore, this section aims to fill the gap by presenting a comprehensive review of the various forms of corruption present in the mentioned sectors. The objectives of this section are to identify the forms available and present a conceptual framework for easy identification of the identified forms. Grasping an in-depth understanding of the various forms of corruption is very crucial to the development of anti-corruption measures (Bowen et al. 2012; Søreide 2002; Tanzi 1998; Le et al. 2014; Shan et al. 2016).

Therefore, this section provides vital information to industry practitioners, policymakers, and anti-corruption institutions in various ways, such as the formulation of anti-corruption measures and easy detection or identification of corrupt practices. To the academic and industry researchers, this section offers them the basis of delving into deeper research works with regards to forms of corruption. With the identification of new forms of corruption, innovative frameworks can be formulated in a more specific manner to tackle corruption from all angles, thereby leading to the reduction of these practices

in the short term and hopefully eradicating their existence in the long-term run. The aim and the objectives of this section are discussed the subsequent sub-sections.

3.2.1 Findings from Studies on the Analysis of Corruption Forms

An appreciable number of publications have identified and explicated different forms of corrupt activities that take place in the construction sector, although comparatively small regarding total identified publications retrieved for this review. An unstructured review of different publications was also conducted randomly to find out if there were other forms of corruption peculiar to construction that was not identified in the selected publications for this review. It was discovered that all the identified forms in **Table 3.1** constituted the forms identified in other publications, thereby justifying the suitability of the selected papers for this section of the review. Conversely, forms of corruption that did not have a direct correlation with the construction industry were discovered; for example, the identification of plagiarism in the education sector. This notwithstanding and based on the comparative study of the identified forms in **Table 3.1** and the randomly selected publications, the forms of corruption in construction identified in this study are considered comprehensive because they captured all the forms of corruption captured in the random papers.

At the end of this section's review, 39 publications were identified to explicate the forms that do occur as corrupt practices in the construction industry. Also, from these 39 publications, a total of 28 different forms of corruption in the construction industry were captured. As presented in **Table 3.1,** the numbers 1–39 represent the papers retrieved for the review and the markings with the symbol (x) represent the frequency of an identified form among the publications. For example, publication number 8 is a paper authored by Tsai, J. S., and Chi, C. S. In this paper, the authors captured two forms of corrupt practices; similarly, bribery as a form of corruption was identified by 27 different publications as shown in **Table 3.1.** Also, from **Table 3.1,** the evolution of corruption over the years has led to the emergence of many other forms in the industry. The most identified CFs in the selected papers included bribery, collusion, fraud, collusion, embezzlement, nepotism, and extortion. All the forms are briefly described to provide

some information to stakeholders and industry practitioners. After the identification of the CFs, it was realized that some of the forms were identical based on the definitions and classifications done in other studies. A conceptual framework of CFs categories was then developed with the aim of providing easy identification of CFs and clear direction in the application of anti-corruption measures (ACM).

Table 3.1: Corruption Forms (CF) Identified in the Literature

Form	Publication																																							
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	Total
Bribery		x	x		x		x	x	x		x		x		x	x		x			x	x	x	x		x	x	x	x			x	x	x	x	x	x	x	x	27
Fraud (Falsification)		x		x			x			x	x		x	x	x	x		x					x	x						x		x	x	x	x	x	x		x	20
Collusion	x	x		x							x		x	x	x	x	x	x	x				x	x								x	x	x	x		x		x	19
Embezzlement							x	x			x							x														x	x	x			x		x	9
Nepotism		x															x	x							x						x	x							x	7
Extortion															x						x			x								x		x		x			x	7
Conflict of interest				x							x		x																			x	x				x		x	7
Big rigging	x										x							x						x								x	x				x			7
Kickbacks							x			x								x														x				x	x			6
Professional negligence				x							x		x										x									x								5
Front/ shell companies											x							x														x					x		x	5
Favoritism/ Cronyism					x							x				x			x																					4
Dishonesty													x										x									x			x					4
Facilitation payments																					x																	x	x	3
Price fixing											x			x				x																						3
Guanxi																				x		x									x									3
Patronage						x												x																					x	3
Client abuse/ clientelism																																	x						x	2
Ghosting											x							x																						2
Influence peddling											x																							x						2
Money laundering																																		x					x	2
Lobbying																																							x	1
Intimidations and threats																x																								1
Coercion																								x																1
Cartels																																		x						1
Blackmail																																				x				1
Solicitation																																							x	1
Deception																																		x						1

3.2.2 Categorization of the Corruption Forms

As presented in **Table 3.1,** the review conducted revealed the prevalence of several forms of corruption that exist in the construction industry. However, to better understand these forms, it is expedient to categorize them into constructs to set out the differences that exist among them. The classification was done purely on two premises: (1) the relationship and the commonalities that exist among the variables (by definition), and (2) from previous studies that classified some of the variables. For instance, Powpaka (2002) classified kickbacks as a form of bribery act in his studies. Similar classifications by other studies were followed to develop the framework as presented in **Fig. 3.1.** The discussion section reveals other examples of the classification. **Fig. 3.1** presents a conceptual framework of the classification of CFs into identical constructs based on their definitions.

3.2.3 Corruption Forms Constructs

The constructs are bribery acts, fraudulent acts, collusive acts, extortionary acts, discriminatory acts, and unclassified acts. The bribery acts construct like other constructs were framed based on the commonalities of the variables with regards to their definition and also based on the classifications of other previous works. Because of word and space limitations, all the forms are briefly discussed within their primary constructs.

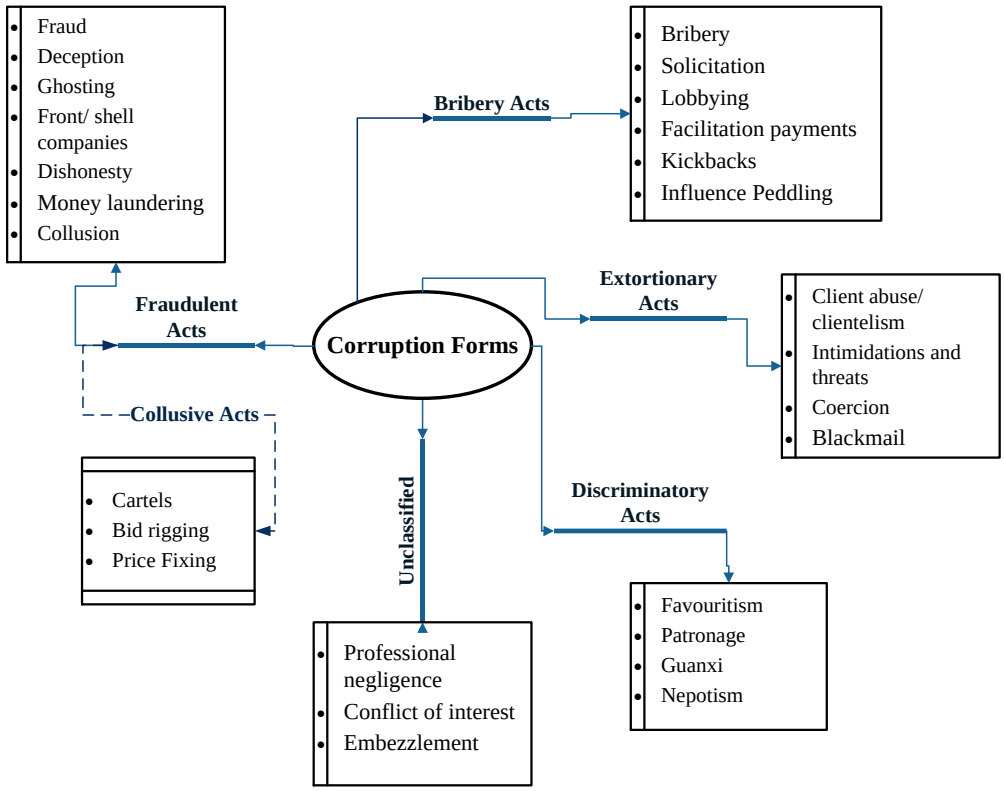


Figure 3.1: Conceptual Framework for CFs classification

3.2.4.1 Bribery Acts

Based on the relationship s that exist among the variables within the construct, bribery acts consist of bribery, kickbacks, facilitation payments, influence peddling, lobbying, and solicitation. These are briefly discussed as follows. Bribery refers to a corrupt act that may involve giving, promising, soliciting, accepting, or offering a benefit to lure or entice someone to act in an unethical or illegal manner. Enticements can be in the form of rewards, fees, loans, gifts, or any supplementary advantage such as donations, special treatment, or services. Any act of this form in the construction industry or procurement is deemed bribery (Le et al. 2014; Meduri and Annamalai 2013; Wang et al. 2000; Loosemore and Lim 2016; Zhi 1995). As mentioned by Noonan (1984), bribery acts constitute the first-ever corruption case. Although there have been countless mention and identification of this form in the industry, according to this review, the first mention of a bribery case was recorded in construction projects was by Stuckenbruck and Zomorrodian (1987). Bribery was identified by 27 out of 39 different

publications constituting over 70% of the entire publications reviewed. Therefore, this ranks bribery as the topmost recorded form of corruption in the industry. The next mentioned bribery act is a kickback. Per the study of Sohail and Cavill 2008; Adams 1997; Brown and Loosemore 2015, kickback may refer to an illegal act where a secret payment is demanded by an individual in a coercive position from another party in search of an advantageous or a biased decision. Kickbacks, per Powpaka (2002), are effectively described as bribes, although it can also be regarded as extortion. Kickbacks were identified by 6 out of 39 publications. Solicitation is the act of enticing, ordering, influencing, or asking another party to indulge in the act of bribery or other corrupt behaviors (TI 2016). A typical example of this form is shown in the thematic responses by the respondents involved in a study by Bowen et al. (2012).

However, the form is not mentioned in their study. Facilitation payments are regarded as small bribes that can also be termed as grease or speed payments normally made to speed up or secure an action to which the briber already has authorized or other rights to (Liu et al. 2004; Kenny 2012; TI 2016). This form of corruption is not new to the industry. However, only three studies identified facilitation payments as a CF in the industry. Lobbying refers to any corrupt act that is undertaken to influence the decisions and policies of an institution to favor an outcome or a course. These acts may turn out to be very misleading if there are inconsistencies in the existence of different stages of influence by individuals, organizations, associations, or different institutions (TI 2016). Influence peddling is described as the use of one ’s status or influence on behalf of another person for a special advantage in return for financial favors or other benefits. For instance, during a contract award stage of a project, if a senior procurement officer manipulates the process by using his power to unfairly influence the decision to favor a contractor in return for a percentage of the contract sum, the act is termed as influence peddling and the official involved is known as the peddler. The actor is often regarded as an influence peddler (Bowen et al. 2012; Stansbury 2009).

3.2.4.2 Fraudulent Acts

Fraudulent acts in the construction industry consist of fraud, collusion, front/shell companies, dishonesty, ghosting, money laundering, and deception. However, under collusive acts that are

classified as fraudulent acts, the variables consist of bid-rigging, price-fixing, and cartels. These are briefly described as follows. Fraud simply refers to the act of deception with the intention to cheat. This takes place when a party deceives another person with the aim of gaining an illegal or unfair advantage (contract award, financial, political). Some countries consider this offense as a felonious act or violating civil laws (Le et al. 2014; Meduri and Annamalai 2013; Wang et al. 2000; Tsai and Chi 2009) Ghosting refers to an entity (either an individual or a unit) made-up for the purposes of fraudulent act or deception (Bowen et al. 2012; Brown and Loosemore 2015). Front/shell companies refer limited liability companies or corporations that have no corporeal existence regarding jurisdiction, no commercial activities, nor are they made up of any real employees.

They are typically established within secrecy or tax haven jurisdiction with the primary purpose of shielding the actual beneficial proprietor from either disclosures or taxes or both (Bowen et al. 2012; Brown and Loosemore 2015; TI 2016). Dishonesty can be described as an act of lying, stealing, or cheating with the primary aim of acquiring, converting, or disposing of either tangible or intangible property to obtain an upper hand or a benefit. It can be defined as fraud in criminal law and can include either pretense or act deceitfully to obtain a benefit. Deception refers to the act of presenting wrongful information to mislead another person concerning a situation that in itself is true (Stansbury 2009). Collusion is regarded as an undisclosed arrangement that exists among the parties involved, either in the private or public sector or both, who meet to conspire to commit deceitful or fraudulent acts to gain illegitimate rewards such as financial gains. The participants who normally engage in collusive acts are known as cartels (Dorée 2004; Shan et al. 2016). Money laundering refers to the act of concealing the ownership, source, or the end point of money obtained in an unlawful of a dishonest manner and secretly placing it in legitimate ventures or projects to make them look lawful (Stansbury 2009; TI 2016).

3.2.4.3 Collusive Acts

Under the collusive acts construct, the factors identified were cartels, bid-rigging, and price-fixing. A cartel, also regarded as a form of collusive act and similar to bid rigging, transpires when two or more firms arrange or enter into an agreement to limit the flow of materials or fix the prices of goods they

control in a specific industry (Stansbury 2009). Bid rigging refers to a collusive act where consenting participants settle on the results of a bid process beforehand. For instance, in some cases, a bidder specifies a very limited time for the preparation of tender documents with the sole aim of controlling the number of prospective bidders. Therefore, only those who were given prior notice of the upcoming bid stand the chance of submitting adequate tender documents (Dorée 2004; Bowen et al. 2012; Brown and Loosemore 2015; Sichombo et al. 2009). Price fixing is a collusive act analogous to big rigging. With this act, a sect of competitors or tenderers colludes to either manipulate or fix prices rather than observe an open market competition (Tabish and Jha 2011a).

3.2.4.4 Discriminatory Acts

Discriminatory acts simply depict the actions of showing more concern or favors that are ethically and professionally wrong. They include nepotism, favoritism, patronage, and guanxi. Favoritism refers to the act of offering special treatment to either an individual or a group of persons, and it often takes the form of awarding a contract, honoring, hiring, benefits, among others, even though the person may not necessarily be qualified for the position or the contract offered. It is regarded as a comprehensive term because it manifests itself in the form of cronyism, nepotism, and patronage (Wang et al. 2000; Ling and Tran 2012; Wibowo and Wilhelm 2014). Nepotism refers to an act where an individual in a position grants favor to either a relative or a friend without suitable regard to qualification (Willar et al. 2016; Corvellec and Macheridis 2010). Patronage is regarded as a form of favoritism where an individual is offered a job, award contract, or other benefits regardless of their entitlement or qualifications and it is normally due to either the individual 's connections or affiliations (Waara and Bröchner 2006; Brown and Loosemore 2015; TI 2016). Guanxi is a Chinese term for nepotism, although not all guanxi may be termed unlawful. In some cases, it turns to favor the parties that have good connections in a local domain, but it becomes unlawful when the favor is granted to a party or group of persons not deserving the favor (Weisheng et al. 2013; Ke et al. 2011; Xu et al. 2005).

3.2.4.5 Extortionary Acts

Extortionary acts are forceful acts that induce fear in the victim intending to make the victim act against his will or to benefit the oppressor, who is mostly of a higher status. They include extortion, client abuse/clientelism, intimidations and threats, coercion, and blackmail. Brief descriptions are given as follows. Extortion refers to the direct or indirect act of using one 's power, knowledge, or status to coercively threaten others in the form of demanding unmerited benefits, compensations, or benefits (Transparency International 2018). Intimidations and threats are regarded as a form of extortion where an individual intentionally induces a sense of subjection, inferiority, or fear into another person or group of persons to frighten them into making them do what the intimidator wants. Blackmail can be described as a condition or act when a party threatens another party if the latter party does not render some privileges or advantages demanded by the former party and the threats are usually in the form of punishment or a mean act as observed in the act of coercion. This was revealed by Smith (2009), but it is rarely mentioned in the industry. Coercion is regarded as a direct or indirect act of committing harm, prejudice, or threats to negatively influence the actions of another person often to favor the coercer (Sichombo et al. 2009). Client abuse/clientelism refers to a biased arrangement of exchanging goods, favors, or resources on a manipulative affiliation between a powerful party and a punier client (Zhang et al. 2016; TI 2016).

3.2.4.6 Unclassified Acts

This construct is named unclassified because no literature classified them. Although there is a commonality among the three variables of a negative professional attitude, no literature has classified them, and hence they are left unclassified. They include embezzlement, conflict of interest, and professional negligence and are briefly discussed as follows. Embezzlement refers to an act where an individual misappropriates, traffics, or uses either goods or funds of an organization or an institution entrusted in their care for personal benefits. For example, when a contractor diverts construction materials allocated for execution of a project, the contractor is said to have embezzled the client's goods because the client is most often the financier of the project (Sohail and Cavill 2008; Tsai and Chi 2009; Bowen et al. 2012). Conflict of interest in the construction industry refers to the situation where a

professional of the industry is challenged with a choice of deciding between the demands and duties required by profession and their respective personal interests (Ho 2013; Bowen et al. 2012). Professional negligence was insinuated as corrupt conduct in the construction industry that occurs when professionals fail to provide the duty of care that a reasonably careful, and prudent professional would offer given the same conditions. For example, some recorded negligence acts include inadequate supervision, deficit in material quality, or insufficient requirements regarding safety (Ho 2011, 2013).

3.3 Causal Factors of Corruption[3]

Corruption is known for breeding cynicism, dents societal values, demeans those involved, hinders decision-making and degrades the quality of projects. Hence it reduces the lifespan of buildings, depriving most inhabitants of quality living. Most importantly, it results in the loss of human lives and properties among other devastating and damaging effects (Lewis, 2003; Transparency International 2005; Boyd and Padilla, 2009). It is therefore deemed to be very deadly, even more, deadly than a disease and it is necessary that all participants of the industry including professionals, clients, and the government except for the corrupt, concur on a cooperative effort to tackle this issue and should not be viewed as a competitive issue (Boyd and Padilla, 2009). Researchers and anti-corruption institutions have played active roles in examining some of these negative drivers, which are referred to as the causes of corruption according to this section. The incessant devotion to corruption research in the construction industry over the years has, therefore, revealed several causal factors that contribute to the incidences of corruption. However, little efforts have been made to systematically review all the causes of corruption in the construction industry and IP, even though they are vastly identified in different studies and contexts. This section, therefore, aims to fill the gap and add on to the existing body of literature by presenting a thorough review of the causal factors of corruption in the construction industry, which is vital and needed for further research.

[3] This chapter is fully or partially published in the following journal article:Owusu, E. K., Chan, A. P., & Shan, M. (2017). Causal factors of corruption in construction project management: An overview. *Science and engineering ethics*, *25*(1), 1-31.

The main aim of this section is to review the body of literature dedicated to the causes of corruption in the construction industry regarding the existing causal factors of corruption, the annual trend of publications, and the thematic categorization of the variables. However, in the quest to realize the set aim, 34 carefully identified publications were consulted as highlighted in the preceding section, and 44 distinct causes of corruption were identified. After the identification of the variables, the authors recognized the similarities and the identical relationships among some of the variables. This led to the categorization of the variables under five newly developed constructs forming the basis for the conceptual framework for the causes of corruption in the construction industry. The succeeding sections explicate the annual trend and the constructs into details.

3.3.1 Findings of Corruption Causal Factors

Following a comprehensive review of selected 34 publications, all the identified causal factors of corruption are presented in **Table 3.3**. In short, 44 distinct factors were identified as causal factors of corruption in the construction industry. The references for the identified factors are presented in the third row of **Table 3.3,** and full details for the references are captured in Appendix A. The relationship considered between the second column from the left representing the causes of corruption and the third column labeled publications is the frequency or the number of publications that cited a particular causal factor. For instance, the lack of rigorous supervision identified as the six factors were identified by five different publications (2,7,17,18 and 24). This same was done for each factor to highlight the number of factors from the resulting publication. After the identification of the variables, they were categorized into five constructs, namely Psychosocial-Specific Causes, Organizational-Specific Causes, Regulation-Specific Causes, Project-Specific Causes, and Statutory-Specific Causes, which are discussed in the next section.

Table 3.2: Causal factors of corruption in construction

No	Causal Factors of Corruption	Publications
1	Poor professional ethical standard	[2]; [16]; [17]; [19]; [20]; [21]; [24]; [25]; [26]; [27]; [30]; [34]
2	Over close relationships	[1]; [2]; [5]; [6]; [7]; [8]; [9]; [15]; [18]; [25]; [26]; [31]
3	Negative industrial and working conditions	[2]; [7]; [12]; [16]; [17]; [30]; [33]
4	Negative role models	[2]; [7]; [12]; [18]; [25]; [32]
5	Personal greed	[11]; [12]; [16]; [17]; [24]
6	Lack of rigorous supervision	[2]; [7]; [17]; [18]; [24]
7	Inadequate sanctions	[2]; [7]; [12]; [18]; [33]
8	Flawed regulation system	[2]; [12]; [16]; [17]
9	Deficiencies in rules and laws	[2]; [3]; [14]; [18]
10	The nature of infrastructure projects	[18]; [32]; [34]
11	Over competition in tendering process	[11]; [16]; [24]
12	Low wage level	[2]; [18]; [29]
13	Great project complexity	[2]; [32]; [34]
14	Multifarious licenses or permits	[2]; [7]; [18]
15	Lack of pro-active steps by funders to limit corruption on projects	[18]; [33]
16	Absence of efficient and responsible administrative systems	[10]; [28]
17	Government influence	[10]; [34]
18	Insufficient legal punishments and penalties	[14]; [33]
19	Fierce competition	[16]; [17]
20	Weak procurement / contractual structures	[12]; [16]
21	Absence of control mechanism	[12]; [33]
22	Transition of governments or economies	[22]; [28]
23	The nature of corruption being a secret activity	[16]; [34]

24	Complex contractual structure	[18]; [34]
25	Appointment of a local representative who acts on behalf of the firm to obtain contracts	[29]; [34]
26	Economic Survival	[16]; [34]
27	Inappropriate political interference	[2]; [11]
28	Delaying the payment of workers' salaries	[22]
29	Lack of legal awareness	[4]
30	Lack of coordination among Government departments	[4]
31	Poor documentation of records	[4]
32	Insufficient transparency in the selection criteria for tenderers	[11]
33	Complexities of institutional roles and functions	[11]
34	Asymmetric information amongst project parties	[11]
35	Lack of standardized execution in construction projects	[13]
36	Negative encouragement	[16]
37	The influence of *guanxi*	[16]
38	Absence of project anti-corruption systems	[18]
39	Subjecting workers to job insecurity	[22]
40	A feeble semblance of public interest	[23]
41	Misrepresentation of qualification certificates	[24]
42	Monopoly	[25]
43	Lack of frequency of projects	[34]
44	Deregulation in the public construction	[2]

1=Dorée (2004); 2=Le et al. (2014); 3=Zhang (2005); 4= Iyer & Sagheer (2009); 5= Ling and Tran. (2012), 6= Yow et al. (2004); 7=Brown & Loosemore (2015); 8= Ning (2014); 9= Ling et al. (2014); 10= Stuckenbruck & Zomorrodian (1987); 11= Sohail & Cavill (2008); 12= Bowen et al. (2012); 13= Tabish & Jha (2011); 14= Bologna & Nord (2000);15= Chan et al.(2003);16= Zhang et al.(2016);17= Le et al.(2014);18= Tanzi (1998);19= Liu et al.(2004);20= Moodley et al.(2008);21= Zarkada-Fraser & Skitmore (2000);22= Alutu (2007);23= Porter (1993);24= Shan et al.(2016);25= Damit (1983);26= King et al.(2008);27= Fan & Fox (2009);28= Shan et al.(2015);29= Boyd & Padilla(2009);30= Hartley (2009);31= De Jong et al.(2009);32= Krishnan (2009);33= Stansbury (2009);34= Locatelli et al. (2016)

3.3.2 Categorization of Variables

Following the studies of Zhang et al. (2017); Le et al. (2014); Tabish and Jha (2011) and Zou (2006), and with the help of thematic analysis approach, the 44 variables causes of corruption identified from the review were categorized into five primary constructs. Le et al. (2014) identified ten causes of corruption in the Chinese public construction sector and categorized them into two main constructs, namely flawed regulation system and lack of positive industrial climate. Similarly, Zhang et al. (2017) also identified 24 causes of corruption in the Chinese tendering process and classified them into six unique construction. Other studies as well have developed similar constructs, which are mostly regulation-specific causes, industrial-specific causes, project-specific causes, etc.

This section followed the same approach to construct categorization. However, since the review process included a vast range of CM publications, a high number of variables (44 in number) were identified, and the thematic analysis approach was employed to factorize the newly identified variables. A thorough reading on each of the variables was made to draw out their main themes to aid in the categorization process. At the end of the process, the five different constructs that were developed are Project-Specific Causes, Regulation or Legal-Specific Causes, Statutory-Specific Causes, Organizational-Specific Causes, and Psychosocial-Specific Causes. These constructs serve as the extension of the body of knowledge devoted to corruption research in the construction industry. After the formulation of the constructs, a conceptual framework (**Fig. 3.3**) of the causes of corruption in the sector was developed. This framework enlisted all the five newly formulated constructs.

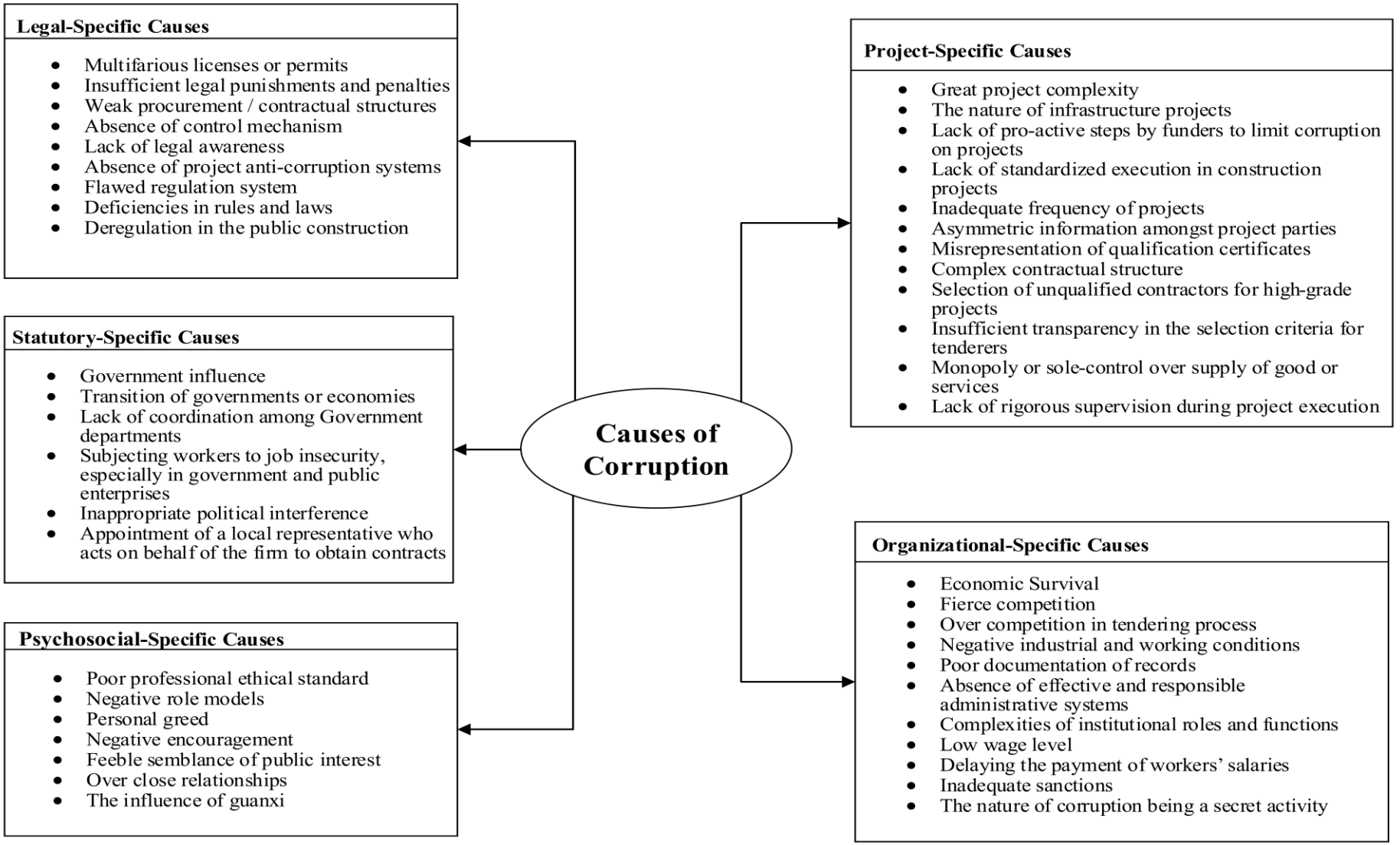


Figure 3.2 Conceptual Framework for causes of corruption

Fig. 3.3 represents the framework developed for the identified variables within their respective constructs. They include Project-Specific Causes, Regulatory-Specific Causes, Statutory-Specific Causes, Organizational-Specific Causes, and Psychosocial-Specific Causes. It should be noted that the generated constructs are not independent of each other since they can all directly or indirectly affect the construction processes and projects. For instance, regulation specific matters can apply to projects as well, although, from the categorization, there could be an assumption that project-specific causes are only related to construction projects. Explanations to each one of the constructs are discussed in the succeeding section. The intensity of their occurrences based on the number of times mentioned in the literature is determined using the mean score approach.

3.3.2.1 Psychosocial-Specific Causes (PSSC)

PSSC construct was developed out of the thematic analysis approach. It represents the psychological and relational or social causes of corruption in the CM. Psychosocial relates to the interconnections of social factors such as relationships and psychological attributes and their influence on the environment, in the workplace or the process of work execution, etc. (Heiser, 2001; Greitzer, 2013; Merriam-Webster, 2017). Also, per the definition and its theoretical underpinning, a total of 7 causal factors were classified under this construct. As compared to the other constructs, PSSC was ranked the first construct with a mean score of 5.43 per the frequency of the individual factor citations recorded in this review and was also rated the second construct with the least variables of seven. However, the top three variables under this construct were revealed to have very high scores as compared to the other causal factors.

Moreover, the mean score obtained by the PSSC construct demonstrates that the psychological issue or causal factors of corruption in the CPM are very critical and require psychological or ethical interventions since these causal factors are human-oriented. Examples of PSSC include poor professional, ethical standard, over close relationships, negative role models, personal greed and negative encouragement (Moodley et al. 2008; Shan et al., 2016; Dorée 2004; Le et al., 2014; Brown and Loosemore, 2015; Bowen et al., 2012; Tanzi, 1998). Other PSSC variables include weak impression of public interest or what may be termed as the lack of public interest in corruption issues and the

influence of guanxi, which is a Chinese word for nepotism or favoritism (Sohail and Cavill, 2008; Bowen et al., 2012; Zhang et al., 2016).

Poor professional, ethical standard, negative role models, and Negative encouragement are all inherent psychological issues that directly or indirectly affect not only junior staff within the industry or working environment but other senior professionals as well. Setting an example as a corrupt leader can create a league of corrupt followers, and the cycle continues until most, if not all, the professional becomes corrupt. It is sometimes hard to bring to check a senior professional who has tasted the benefits of corruption since early beginnings as junior staff. Setting a negative standard as a role model as well as offering negative encouragement, in the authors' opinion, can be termed as the mother of all forms of corruption. The statement is based on the postulation that all forms of corruption have to commence with parties with negative intentions to engage in corruption (Henry, 2009), and the topic of corruption is as well skewed towards the concept of negative human ethics. Although this argument may be arguable, it is psychologically indicated that positive leadership or role models, as well as positive encouragement, are likely to create a positive working atmosphere (Bass, 1985; Jung and Sosik, 2002).

Also, Personal greed, which is another psychological issue of human ethics, refers to the extreme selfish desire of a person to acquire wealth, which is often presented in the form of money or other valuable resources (Dhiman, 2008). And the desire to want more causes professionals to engage in corruption (Sohail and Cavill, 2008; Bowen et al., 2012). On the side of relational instigators, overclose relationships have contributed immensely to the evolution of varying forms of corrupt or discriminatory acts in the CPM such as favoritism, nepotism, cronyism and patronage and guanxi as described in the Chinese context (Wang et al., 2000; Ling and Tran, 2012; Wibowo and Wilhelm, 2014; Weisheng et al., 2013; Ke et al., 2011; Xu et al., 2005). The variables within this construct have also led to the eruption of other forms of corruption identified in tendering processes such as collusion acts which may include cartels, bid-rigging and price-fixing (Dorée, 2004; Bowen et al., 2012; Brown and Loosemore, 2015; Sichombo, 2009; Stansbury, 2009). Moreover, deep research is needed, especially in the area of corruption in the CM, to ascertain practical measures on how to effectively deal with the high rate of

overclose relationships in the industry. Lastly, in a general setting or public domain, where there is a feeble semblance of public interest, or a large percentage of the population fails to report corrupt practices of any form, there is a high possibility of corruption to flourish in that particular environment.

3.3.2.2 Organizational-Specific Causes (OSC)

OSC are causal factors that emanate from organizational structures or institutions. In other words, they are corrupt institutional influences from both the public and private construction sectors that negatively affect the entire industry and create room for corruption to occur. They include negative industrial and working conditions, over competition in the tendering process which encourages some contractors or construction firms to engage in corruption to be awarded the contract (Brown and Loosemore, 2015; Bowen et al., 2012; Zhang et al., 2016; Hartley, 2009). Others, which include inadequate sanctions, low wage level, economic survival of institutions and the absence of efficient and responsible administrative systems, among others are briefly discussed in the succeeding section (Le et al., 2014; Brown and Loosemore, 2015; Bowen et al., 2012; Tanzi, 1998; Stansbury, 2009; Sohail and Cavill, 2008).

OSC construct is ranked second highest among the constructs with a mean score of 2.64, and the construct is as well made up of 11 out of 44 variables, just as observed in the case of PSC construct, making it also one of the leading constructs with most variables. Therefore, as encountered in the situation of the causal factors associated with project initiation, execution, and completion, organizational causal factors also tend to have adverse effects on the commencement and completion of a project. For instance, bidders representing their various construction institutions may be pushed to ask for a favor from the contract awarding body due to the excessive numbers of bidders who have all tendered in for a project (Zhang et al., 2016; Shan et al., 2016). This, in turn, places the contract-awarding body in a position to accept bribery from capable contractors and at the end, rigs the entire bidding process. This variable, over competition in the tendering process, is also regarded as one of the leading causes of bid-rigging in the infrastructure procurement process (Le et al., 2014; Stansbury, 2009).

The struggle for economic survival also forces some construction and consulting firms to engage in corruption (Zhang et al., 2016; Locatelli et al., 2016). Resorting to corruption in situations like this can sometimes remain the only or last option for some industries to survive and stay competitive in declining economies. Such firms would do whatever possible to keep them surviving rather than to get out of business. Also, when there is fierce competition in the construction market or over competition in the tendering process, unethical professionals from both the contracting or bidding firms and contract awarding body may manipulate or rig the entire process to favor the 'briber' (Sohail and Cavill, 2008; Le et al., 2014; Shan et al., 2016). This action from the two corrupt parties or institutions most often succeeds because of the nature of corruption is a secret activity (Zhang et al., 2016). In the instance of Negative industrial and working conditions such as low wage level, underpaid staff may also supplement their remuneration earnings with petty facilitation payments and see either very little or no need to refrain from such acts. Also, when they realize that their leaders are misappropriating monies or resources that could have been used to increase their wages or better their living conditions, they tend to help themselves out through corruption (Tanzi, 1998; Boyd and Padilla, 2009).

Moreover, delaying the payment of workers' salaries can result in the same condition described above (Alutu, 2007). Poor documentation of records and the complexity of institutional roles and functions are other problematic subjects encountered in other organizations that create the vacuum for corruption to thrive (Iyer and Sagheer, 2009). On the issue of the absence of efficient and responsible administrative systems and Inadequate sanctions as OSC variables, Bowen et al. (2012) revealed that without effective policing strategies and adequate sanctions to check corruption in awarding government contracts, the whole process is can be rigged. The authors opined that these were some of the cases recorded in South Africa (SA) construction industry. The absence of political will to combat the incidence of corrupt practices in SA poses the difficulty in imposing discipline or adequate sanctions to corrupt parties in the SA construction sector. This, therefore, creates more room for the frequent occurrence of corrupt practices since those involved are occupied with the notion that they will go unpunished even when caught in the act (Krishnan, 2009; Bowen et al., 2012; Stansbury, 2009).

3.3.2.3 Regulatory or Legal-Specific Causes (RSC)

The RSC construct consists of causal factors that are skewed towards regulations, norms, or principles guiding modus operandi and the activities of the CPM or, to an extent, legal matters associated with the CPM. The composing variables of this construct are very critical in every project management in construction since every project and activity within the industry is guided by contracts, regulations, principles, bonds, and others. Per the assessment of this review, the RSC construct is ranked 3rd with a mean score of 2.22 with nine causal variables. The leading variables within RSC are flawed regulation system (FRS) of most construction public sectors, (Le et al., 2014; Bowen et al., 2012; Zhang et al., 2016), deficiencies in rules and laws and multifarious licenses or permits (Zhang, 2005; Bologna and Nord, 2000; Tanzi, 1998). FRS was identified by Le et al. (2014) as one of the leading causes of corruption, the Chinese construction public sector. In any setting, whether the private sector or public or even in the execution of a project, when the entire regulatory system intended to guide the effective implementation of activities is flawed, there is a possibility for corruption to happen.

The departments within the public construction sector as well that of the private are expected to ensure a sound set of regulations or principles governing every single activity and behaviors of professionals are in place and active. Prominent causes the RSC Include insufficient legal punishments and penalties, weak procurement / contractual structures, the absence of effective control mechanism, lack of legal awareness on the part of professional or construction workers, the lack of project anti-corruption systems and deregulation in the public construction (Le et al., 2014; Brown and Loosemore, 2015; Tanzi, 1998). Right from the conception of a project to its realization, the identified RSC variables may lead to adverse consequences that can either halt the execution of a project or terminate it entirely. Compromising on any of the set laws or regulations guiding the industry or project execution may lead to adverse consequences in the industry, and it is necessary that industry practitioners and project executioners conform to laws, principles, and regulations guiding a project. Conforming to rules and regulations is very critical, not only in the CM but other sectors as well and, most importantly in the public sectors (Brown and Loosemore, 2015; Bologna and Nord, 2000).

3.3.2.4 Project-Specific Causes (PSC)

PSC refers to the causal factors or instigators that lead to corrupt activities in a construction project. Although the list within this construct may apply to other situations as well, attributed explicitly to construction projects, in other words, without construction projects, some of the causes within the PSC construct would not be in existence. Transparency International (2005) identifies two forms of construction projects, namely minor and major projects, as well as two primary types of corruption, namely petty and grand corruption, and argue out that. In contrast, minor projects are susceptible to petty corruption; large projects or contracts are liable to grand corruption. The principal variables noted under this construct include Lack of rigorous supervision during project execution, great project or infrastructure complexity as well as the complex contractual structure involved in projects (Le et al., 2014; Brown and Loosemore, 2015; Tanzi, 1998; Shan et al., 2016).

Other notable variables include the lack of pro-active steps by funders to limit corruption on projects and also the lack of standardized execution in construction projects (Krishnan, 2009; Locatelli et al., 2016; Krishnan, 2009; Locatelli et al., 2016). In all, 12 causal factors were classified under the PSC construct. As indicated in the previous section, other variables under the four other constructs may directly or indirectly affect a construction project, although the PSC construct is specifically made up of related variables. Per the review, PSC construct is ranked 4th with a mean score of 1.83, due to the low-frequency rate of the citations of its variables in the retrieved papers, it is regarded as a highly important construct because it recorded the highest number of 11 out of 44 variables, same with the OSC construct. This depicts how the nature of construction projects tend to record a high number of corruption cases. According to the review, the lack of rigorous supervision during project execution happens to be the leading variable under this construct. This variable has been regarded not only as a causal factor of corruption in project works but also threat to timely execution of projects, increases the overall intended cost, and affects the quality of projects, which represents (the three main objectives of any construction project). Failing to ensure adequate and rigorous supervision of construction projects from the side of the client's representatives tends to create a loose end for the contractor or suppliers to make use of inferior materials or misappropriate the quality materials provided by the client (Brown

and Loosemore, 2015; Tanzi, 1998; Shan et al., 2016). The situation, in either the short or long term, could lead to early deterioration of the projects and reduce the lifespan as well (Le et al., 2014).

The following three, which include Great project complexity, Complex contractual structure, and the nature of infrastructure projects are all complications that evolve as a result of the inability of some of the key members of a construction project to appreciate the whole nature of both projects and contracts. This inability, therefore, creates a space for corruption to flourish. Whereas simple projects tend to yield fewer complications and difficulties with regards to the project itself and its associated contracts, complex projects and contracts do not only need to make use of professional experts who understand the nitty-gritty of the entire project, but must also involve other skilled professionals outside the project team such as professional audit team that understand the project and contracts. Therefore, awarding contracts for bidders who find it tough to appreciate the nature of the project, as well as the contract and the requirements involved, could be a possible cause of corruption. This is just one out of the many examples of how the complexities of projects and contracts may lead to corruption in either a construction process or other industrial activities in general.

3.3.2.5 Statutory-Specific Causes (SSC)

SSC construct is attributed to the government or state-driven factors that propel corrupt practices in the public construction sector. The definition of corruption lends itself to public ventures as compared to that of the private sector (Chan and Owusu, 2017). The public officers are often reported to be the perpetrators of any possible corrupt incident in the construction industry Tabish and Jha (2011). The noted causal variables under the SCC construct include inappropriate political interference and government influence in the award of contracts. Other factors include the appointment of a local representative who acts on behalf of the firm to obtain contracts, the transition of governments or economies, lack of coordination among Government departments and subjecting workers to job insecurity, especially in government and public enterprises (Le et al., 2014; Sohail and Cavill, 2008; Boyd and Padilla, 2009; Stuckenbruck and Zomorrodian, 1987; Locatelli et al., 2016). The SSC factor was identified to be the least rated construct in terms the frequency of citation and the least number of

individual constituting variables, with a mean score of 1.67. However, the variables within this construct were also identified to be very critical in the developing countries and may even represent the leading causal initiators of corruption in the public construction sectors of some developing countries (Osei-Tutu et al., 2010; Tabish and Jha, 2011).

The influence of Government in contract award can either be regarded as a positive act or a corrupt act. In the stance of the positive view, government representatives may choose to award a contract to a contractor or supplier firm due to their long stand reputation in executing quality projects. On the other hand, government representatives may choose to award a contract to a firm based on either political affiliation or any relationship, which depict a typical example form of corruption such as favoritism, nepotism or cronyism. This, to an extent, can be likened to inappropriate political interference (Sohail & Cavill, 2008). Also, the transition of governments or economies does not only creates enough room for corrupt practices to occur but also serves as a common leading cause of project abandonment in the developing world. An outgoing government may choose to abandon ongoing projects and embezzle public funds in economies that do not have adequate systems to detect such practices. Osei-Tutu et al. (2010) reported that an outgoing government could be subjected to a strict audit and accountability process in the case of any hint of corruption.

However, the audit process is required to be executed by highly qualified independent auditors, an anti-corruption institution with such expertise. Lastly, lack of coordination among government departments and workers subjected to job insecurity, especially in the government and public domains just as in the case subjecting workers to low-level salary in OSC construct, puts employees in the position to secure as much as possible and through any means, whatever financial needs needed to secure a healthy future (Alutu, 2007). This then puts the public worker in a position to embezzle public funds through any possible and vulnerable medium.

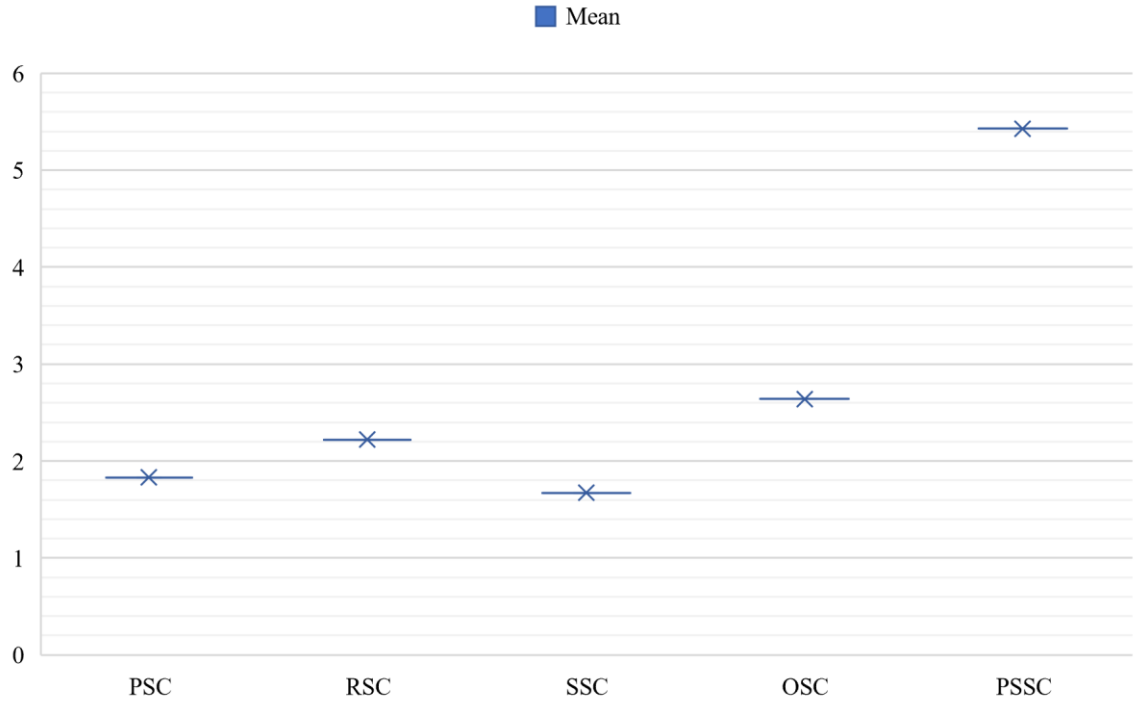


Figure 3.3 Graphical presentation of the constructs mean score

3.4 Anti-Corruption Measures[4]

Developing practical and innovative techniques for combating the pervasiveness of corruption in CPM is essential to the good image, profitability, timely execution, and delivery of high-quality projects. The past years have seen appreciable contributions toward the body of knowledge on corruption in CPM. This development has led to an increase in literature on the subject matter, including anti-corruption measures and frameworks developed to tackle corruption in CPM. However, a comprehensive and systematic assessment of both existing and past research on the subject matter, which is vital for future endeavors, is not available. Also, existing studies show the lack of a unified view of the ACMs and frameworks developed over the past years for the management of construction projects. This section, therefore, reviews the anti-corruption measures (ACMs) developed to mitigate the pervasiveness of corruption in CPM using a two-stage review process to identify the publications and the measures.

The following sub-objectives were set to realize the aim: (1) to review the pattern of publications devoted to ACMs in CPM, (2) to identify the ACMs in CPM, and (3) to develop a conceptual framework to facilitate easy identification of the ACMs and also to set as a guide to enhance existing measures and future development and implementation of more stringent ACMs. The findings contribute to an in-depth understanding of ACMs in CPM. Moreover, this review section is vital to industry practitioners and anticorruption institutions because it renders excellent support to their corruption-free work, thus benefiting the practice. Lastly, this article contributes to the body of knowledge by conducting a comprehensive review of current anti-corruption measures applied in the day-to-day modus operandi and management of construction and engineering projects. Research gaps are identified and discussed, and suggestions are made for future research directions. The checklist and framework developed in this review section are useful for further empirical studies and discussions. The subsequent sections explicate the details of the aim and objectives of this section.

[4] Owusu, E. K., Chan, A. P., DeGraft, O. M., Ameyaw, E. E., & Robert, O. K. (2019). A contemporary review of anti-corruption measures in construction project management. *Project Management Journal*, *50*(1), 40-56.

3.4.1 Preventing Corruption

Several preventive and reactive measures commonly referred to as anti-corruption measures or strategies have been formulated by researchers, anti-corruption institutions, policymakers, etc. They include transparency mechanism, ethical code, administrative reforms stringent rules and legislation, rigorous technical auditing system, whistle-blowing mechanism, contract monitoring, among many others. These measures have been concurred by several empirical studies to be effective anti-corruption strategies formulated to mitigate corruption in the construction sector (Sohail and Cavill, 2008; Boyd and Padilla, 2009; Ho, 2012; Bowen et al., 2015; Shan et al., 2015; Hartley, 2009; Le et al., 2009; Zou, 2006).

Also, these are some of the noted ACMs identified from literature known to be effective against corruption. For instance, Zou (2006) purported three approaches to dealing with corruption in the construction industry. They are stipulated as follows: (1) the development of ethical and honest construction culture, (2) establishing a policy of regular and random inspections, and lastly, instituting construction works and processes supervision throughout the lifecycle of a project. The author pointed out the first approach as a long-term measure, while the following two were regarded as short-term strategies. Although substantial efforts to thwart the incidence of corruption have been stipulated by researchers in the construction field, other notable international organizations such as the United Nations, World Bank, TI, OECD, and the GIACC among many others have as well played active roles in helping to fight corruption either directly or indirectly in the construction industry. These efforts are rarely reported in studies, and as part of the identified preventive measures, this section presents the efforts made by the international organizations in the next subsection. This information may guide researchers as a source of reference to develop further anti-corruption measures or enhance the already existing ones to tackle the causes of corruption identified in the construction industry. However, a detailed list with respective references has been provided in the next section.

Table 3.3: Overview of selected organizational initiatives

Organization	Effort	Origin	Year of effect	Reference
World Bank	Institutional integrity activity	USA	2001	Henry (2009), World Bank (2008)
United Nations	United Nations Convention against Corruption	Mérida and New York	2005	de Jong et al. (2009).
OECD	Convention on Combating Bribery	France	1997 & 1999	OECD (2016), de Jong et al. (2009).
GIACC	Provides resources to assist in the understanding, identification, and prevention of corruption in the infrastructure, construction, and engineering sectors.	UK	2008	Stansbury (2009).
Transparency International	GIACC promotes the implementation of the Project Anticorruption System PACS Openness of the decision-making processes TI produced a suite of anti-corruption tools and reports in 2005. And in 2007 published a Project Anticorruption System PACS for the construction sector.	Germany	2007	Henry,2009). Krishnan (2009).
International Standard Organization (ISO)	ISO 37001 - Anti-bribery management systems	Switzerland	2016	GIACC, 2016
FIDIC	Developed a practical tool, namely a comprehensive Business Integrity Management System BIMS for consulting firms.	Switzerland	1998	Boyd and Padilla (2009); Henry (2009); GIACC (2016)
	In recognition of the multifaceted nature of corruption, in 2007, a parallel Government Procurement Integrity Management System GPIMS was developed for organizations that procured consulting services.	Switzerland	2007	Boyd and Padilla (2009).
ASCE	Set up of Task Committee on Global Principals for Professional Conduct GPPC	USA	2004	Henry (2009).
World Economic Forum	Partnership against Corruption Initiative	Switzerland		Henry (2009); GIACC (2016)
World Federation of Engineering Organizations (WFEO)	Anticorruption Task Group - It has formed an Anti-Corruption Standing Committee, which is tasked with promoting anti-corruption actions internationally.	France	2005	Henry (2009); GIACC (2016); WFEO (2016)
Union of Pan-American Engineering Societies (UPADI)	Anticorruption task group and anti-corruption committee	Brazil	2009	Henry (2009).
The Global Anticorruption Education and Training Project ACET	a training guide, a train-the-trainer kit, and numerous other training materials designed to reduce corruption	USA	2006	Smith (2009).
CIECI – Construction Industry Ethics & Compliance Initiative	The sole purpose of CIECI is the promotion and advancement of ethical conduct and compliance in the construction industry.	USA	2008	WFEO (2016)
CoST – Construction Sector Transparency Initiative	promote increased transparency in international construction projects,	South Africa and the UK	2012	Krishnan (2009); WFEO (2016)

Regarding this review, thirty-eight papers were finally considered valid and relevant and were selected at the end of the two-stage search and after a thorough visual examination. The papers were analyzed in terms of annual publication trends, identification of the ACMs developed, developments of constructs by variable classifications, and explications to the constructs and their composing variables. Regarding the papers devoted to the subject matter in this section, it is quite unfortunate to realize that few papers have empirically dealt with the issue of corruption, particularly on the measures required to deal with corruption over the years. This low record, therefore, calls for critical attention and research on ACMs and more innovative frameworks to tackle corruption in CPM.

Despite the groundbreaking advancements made in construction management research, the industry still lacks innovative approaches to dealing with the corrupt practices identified in the management of construction and engineering projects. This is evident from the annual trend of publications, which has not been very encouraging even though the body of knowledge devoted to corruption, in general, has increased in the past decade. For example, the years 2009 and 2012 recorded the highest number of publications as compared to the previous years and decades. One of the reasons for this increase stems from the special issue on corruption in the CPM raised in 2009 by the Journal of Leadership and Management in Engineering (Owusu et al., 2017). Moreover, it is interesting to note that while corruption has engendered considerable scholarly attention, studies on pragmatic ways to deal with this menace seem to be relatively few—a situation that should be addressed sooner rather than later. The primary lesson to draw is that more research on corruption should be encouraged on an annual basis with respect to developing pragmatic and innovative measures to reduce the alarming rate of corruption in CPM.

3.4.2 Findings from Studies on Anti-Corruption Measures

Although the research studies on ACMs in construction in the selected journals are quite sporadic regarding the number of publications, some of the identified papers conducted comprehensive explications on the identified measures. **Table 3.6** shows the findings of the 38 selected publications,

accumulating and displaying the number of times each ACM appears in a publication. For example, rigorous technical auditing systems and contract monitoring were identified by 13 and 12 different publications, respectively, and the indications [1] and [2] and the numbers represent the individual publications that identified the ACMs. From **Table 3.6,** it is clear that several anti-corruption measures have been developed or proposed to combat corruption in CPM. However, the most identified measures are ethical code, transparency mechanism, training and development initiatives, raising awareness, rigorous technical auditing systems, and contract monitoring. The remaining identified ACMs are presented in **Table 3.6** and explained within their respective constructs. The references for the measures have been presented in the Appendix following the Conclusions section.

Table 3.4: Findings on Anti-Corruption Measures

No.	Anti-corruption Measures	Reference (Order of frequency)	Total
1	Ethical code	[1]; [2]; [3]; [4]; [5]; [6]; [7]; [8]; [11]; [13]; [14]; [15]; [16]; [19]; [21]; [22]; [23]; [25]; [29]; [30]; [32]	24
2	Transparency mechanism	[1]; [2]; [3]; [4]; [6]; [7]; [8]; [13]; [15]; [16]; [18]; [19]; [20]; [21]; [22]; [24]; [25]; [27]; [28]; [29]	21
3	Training and development initiatives	[2]; [5]; [6]; [12]; [13]; [17]; [19]; [20]; [21]; [23]; [24]; [25]; [29]; [31]; [32]; [33]	16
4	Raising awareness	[7]; [12]; [13]; [17]; [21]; [22]; [23]; [24]; [25]; [26]; [29]; [33]; [34]	13
5	Rigorous technical auditing system	[1]; [2]; [4]; [5]; [6]; [7]; [16]; [23]; [24]; [25]; [27]; [29]; [33]	13
6	Contract monitoring	[6]; [7]; [8]; [10]; [12]; [14]; [15]; [20]; [23]; [24]; [25]; [26]	12
7	Comprehensive rules and regulations	[2]; [3]; [5]; [6]; [12]; [13]; [23]; [24]; [25]; [27]; [29]; [30]	12
8	Harsh punishment or penalty	[1]; [3]; [5]; [7]; [12]; [13]; [19]; [21]; [22]; [26]; [31]; [34]	12
9	Whistle-blowing mechanism	[7]; [12]; [17]; [19]; [20]; [22]; [23]; [24]; [25]; [26] [29]	11
10	Compliance to fairness and transparent procedures	[2]; [3]; [4]; [6]; [7]; [11]; [15]; [21]; [23]; [24]	10
11	Education	[5]; [19]; [20]; [24]; [27]; [29]; [31]; [32]; [33]	9
12	Increase in accountability	[4]; [6]; [7]; [15]; [23]; [24]; [25]; [28]; [29]	9
13	Access to information	[2]; [16]; [18]; [19]; [21]; [23]; [24]; [25]	8
14	Corporate governance	[1]; [4]; [10]; [20]; [21]; [23]; [25]; [29]	8
15	Financial disclosure / Disclosure	[7]; [16]; [19]; [23]; [25]; [26]; [29]	7
16	Contractual compliance	[2]; [11]; [12]; [13]; [20]; [23]; [25]	7
17	Good Leadership	[1]; [2]; [5]; [23]; [24]; [29]; [33]	7
18	Professional associations	[7]; [11]; [16]; [28]; [29]; [33]	6
19	Debarment/ Promoting fair debarment procedures.	[1]; [7]; [13]; [19]; [21]; [22]	6
20	Procedural compliance	[2]; [6]; [20]; [23]; [25]; [27]	6
21	Rigorous supervision among others	[2]; [3]; [18]; [19]; [23]; [25]	6
22	Compliance to code of conduct	[6]; [7]; [19]; [23]; [25]; [29]	6
23	Integrity pacts	[1]; [4]; [5]; [7]; [13]; [24]	6

24	Well-structured project governance	[13]; [14]; [23]; [24]; [25]	5
25	Strengthening of professional institutions	[7]; [22]; [24]; [25]	4
26	Existence of procurement rules and legislation	[5]; [23]; [24]; [25]	4
27	Publication of contract and implementation details	[2]; [15]; [23]; [25]	4
28	Enhanced due diligence	[7]; [12]; [16]; [29]	4
29	Administrative reforms	[15]; [18]; [23]	3
30	Effective investigation, court proceedings, departmental disciplinary action	[22]; [23]; [26]	3
31	Development of strong political and ethical will to enforce existing anti-corruption policies and laws	[30]; [33]; [34]	3
32	Checks and balances	[23]; [29]	2
33	Enhance communication	[7]; [23]	2
34	Oversight	[7]; [15]	2
35	Dismissal from employment or other disciplinary action]	[21]	1
36	Anonymous assistance	[17]	1
37	Adherence to professional standards	[33]	1
38	Efficient reporting system (Independent hotline)	[33]	1
39	Information technology	[1]	1

1= Le et al. (2014a); 2= Le et al. (2014b); 3= Zhang et al. (2016); 4= Bowen et al. (2012); 5= Tabish and Jha (2012a); 6= Tabish and Jha (2012b); 7= Sohail and Cavill (2008); 8= Valdes-Vasquez and Klotz (2012); 9= Ho (2012); 10= Shen and Song (1998); 11= Hartley (2009); 12= Krishnan (2009); 13= Boyd and Padilla (2009); 14= Sohail and Cavill (2006); 15= Kenny (2012); 16= Sichombo et al. (2009); 17= Rebeiz (2011); 18= Hawkins and McKittrick (2012); 19= de Jong et al. (2009); 20= Stansbury C. (2009); 21= Stansbury N. (2009); 22= Bowen (2007); 23= Zou (2006); 24= Tanzi (1998) 25= Søreide (2002); 26= Suen et al. (2007); 27= Tashjian (2009); 28= Ling et al. (2014); 29= Brown, J., & Loosemore (2015); 30= Porter (1993); 31= Alutu (2007); 32= King et al. (2008); 33= Powell (2006); 34= Shakantu (2006)

3.4.3 Constructs' Development

Table 3.6 presents the variables identified in the 38 papers selected for this section of the review study. All the 39 ACMs were categorized into six distinct constructs. The development of the categories was done following the studies of Tabish and Jha (2012) and Narasimhan (1997) and employing the thematic analysis approach to extract the main theme of each variable to facilitate the categorization process (Owusu et al., 2017). Previous studies identified and categorized ACMs into two main constructs—namely, proactive and reactive measures (Zou, 2006). Proactive measures represent the ACMs that are strategically developed to prevent or safeguard public and private institutions from the possible occurrence of corrupt actives, whereas reactive ACMs are established to deliver justice or required punishment to offenders or culprits liable to the corrupt offense. The constructs developed in this review further develop the two constructs identified in the studies of Zou (2006), Tabish and Jha (2012), and Narasimhan (1997).

The thematic analysis approach was adopted to facilitate the groupings of the variables into their respective constructs. The approach considered the core theme and meaning of each respective variable. Moreover, other categorizations of some of the successful ACM models developed globally were examined to enhance the constructs' development process. For instance, the Independent Commission Against Corruption of Hong Kong uses a three-pronged approach: law enforcement (regulatory measures), prevention (proactive measures), and education (promotional or publicity measures). Under these three categorical themes exist specific objectives and variables aimed at mitigating corruption in Hong Kong (De Speville, 2010; ICAC, 2016). Thus, following the developments on previous studies and the thematic approach adopted, six main constructs were developed: regulatory measures, managerial measures, probing measures, compliance measures, promotional measures, and reactive measures. **Fig. 3.5** represents the conceptual framework encompassing the developed constructs.

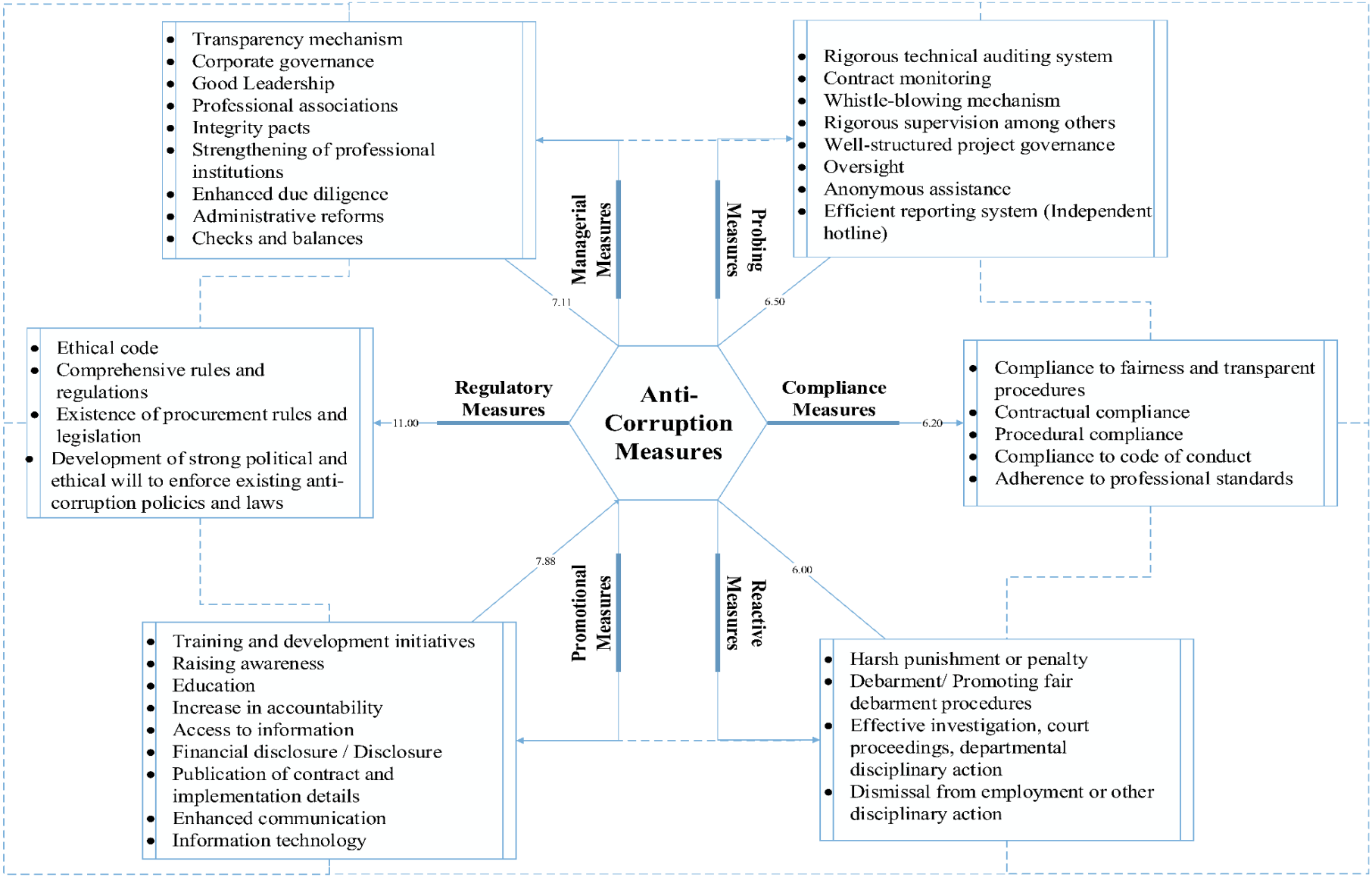


Figure 3.4 Conceptual framework of ACMs in CPM.

3.4.4 Discussion

Fig. 3.5 illustrates the conceptual framework made up of the developed constructs and their respective variables: regulatory measures (RGM), managerial measures (MAM), probing measures (PBM), compliance measures (COM), promotional measures (PRS), and reactive measures (REM). Even though the categorization was developed based on past studies and thematic explications of each variable, it should be emphasized that these constructs are not independent of one another. Inasmuch as the variables have been grouped under specific constructs, some of them may be applicable to other constructs. For instance, ethical codes under regulatory measures can be applied to managerial measures, since administrative bodies and policymakers formulate or develop ethical codes to govern the effective administration of institutions, bodies, and persons involved in CPM. However, ethical codes are better classified as regulatory measures, which cover a broader scope and may apply to both statutory and institutional domains. Depending on the nature or characteristics of the project at hand, specific measures within each construct can be employed to either limit or extirpate the proliferation of corrupt practices at any of the stages involved in the construction process.

However, the application could be based on the empirical determination of likely forms or causes of corruption capable of distorting any phase of the construction process (Chan & Owusu, 2017; Le et al., 2014a; Owusu et al., 2017). The development and explication of each construct are discussed in the subsequent sections. Analogous to the study of Chan and Owusu (2017), the weightings of each variable, based on their number of citations in the papers selected for this section of the review, are determined using the mean score approach. It should be noted that the mean score of each construct does not represent any specific cultural or institutional background, but only indicates the attention given to the explications and application of each variable with its corresponding construct. The mean score of each category is therefore determined by the summation or total frequency of citation of each ACM within its specified category, divided by the specific number of variables, n, forming the category. For example, the mean score of the PBM category was determined, as indicated below:

$$\sum(PBM1 + PBM2 + PBM3 \ldots + PBM8)/_n = \sum(13 + 12 + 11 + 6 + 6 + 2 + 1 + 1)/_7 = 6.50$$

The calculations for the remaining five categories were determined using the same technique, and the results of each category are presented in **Table 3.7** and **Fig. 3.6**, respectively.

3.4.4.1 Managerial Measures

Managerial measures refer to the proactive administrative ACMs set to guide the effective administration of the internal structures of an institution and the relations with other external influences against corrupt practices that possess the potential to distort the managerial systems of an organization. In other terms, these may be regarded as organizational-specific measures. This construct came third, with a mean score of 7.11. The term management here does not only refer to organizational or institutional administrative departments but also stretches to the public-sector management boards. The ACMs identified under this construct, therefore, relate to both public-sector boards in charge of infrastructure procurement as well as other institutions concerned with the construction and management of infrastructure projects. Athanasouli and Goujard (2015) pointed out that corruption decreases aggregate efficiency by weakening stable management practices.

Therefore, to increase administrative or managerial efficiency, it is expedient to develop and implement strategic managerial measures to mitigate or expunge the practices and effects of corruption effectively. Under this construct, the transparency mechanism variable was identified as the leading variable (de Jong, Henry, & Stansbury, 2009; Hawkins & McKittrick, 2012; Ling et al., 2014). A total of 21 out of 38 publications identified transparency mechanism as a significant approach to combat corrupt practices exposed to administrative units involved in CPM (Bowen et al., 2012; Le et al., 2014a; Shen & Song, 1998; Sohail & Cavill, 2008; Zhang et al., 2016). TI (2016) defines transparency mechanism as a distinguishing feature of individuals, organizations, companies, and governments of being more open in carrying out daily operations and processes as well as the dissemination or disclosure of information, plans, and rules. Transparency mechanism is considered one of the main pillars of ACMs in construction procurement (Sohail & Cavill, 2008; Zhang et al., 2016). Developing countries such as Vietnam, the Philippines, Zambia, and Tanzania are believed to have made significant efforts in incorporating initiatives regarding transparency to help eliminate corrupt practices in the management of construction

projects (Goldie-Scot, 2008). A study conducted by Sohail and Cavil (2008) also suggests that adopting a transparency mechanism in providing the public with any information regarding construction projects is necessary to monitor project performance and to hold decision-makers accountable for their decisions. Consistent exposure of implementation details and contracts was regarded by Kenny (2012) as a conventional method to enhance the transparency of a project.

Other managerial measures include corporate governance, which represents the regulations, practices, and procedures by which an institution is controlled or directed professional associations and the strengthening of professional institutions integrity pacts and enhanced due diligence (Krishnan, 2009; Sichombo et al., 2009; Owusu et al. 2018). Studies assert that no successful management or administrative authority can happen without good leadership. Good leadership is, therefore, considered one of the pivotal components of every thriving and successful management board. Le et al., 2014a; Powell, 2006; Tanzi, 1998) and may serve as motivation for encouraging good or acceptable ethical behaviors and, to a large extent, ACMs. According to Wallis (1989), administrative reform refers to an induced, perpetual enhancement in the administration of an institution. There are numerous objectives behind administrative reforms.

However, for this review, AR aims to create an ethical environment and a positive industrial climate, coupled with enhanced productivity, and this can only be achieved through good leadership (Hawkins & McKittrick, 2012; Kenny, 2012; Zou, 2006). Checks and balances represent a system that enables different arms of authority to check, veto, or amend acts of another arm or branch of authority to prevent that branch from abusing or exerting “more than necessary power” (Brown & Loosemore, 2015; Zou, 2006). This system was reported to be an effective ACMs where equally or a more powerful external force is put in place to check the powers delegated to any of the project teams for a project. Ranging from the public procurement body to consulting and contracting teams, external agencies can be put in place to ensure that consenting parties do not abuse nor exert too much of the power delegated to them. This system, in turn, increases transparency and accountability and can prevent the abuse of power, which is seen as the central focus of corruption (Brown & Loosemore, 2015; Zou, 2006). Lastly, to

enhance the performance and strength of management in its dealings or to fight against corruption, the International Standard Organization (ISO) has developed a new set of standards to help organizations fight bribery and promote an ethical business culture. The document is called the Anti-Bribery Management Systems—ISO 37001 (GIACC, 2016). As a flexible managerial anti-corruption tool, the ISO 37001 can be adapted by any institution, private or public, small, medium, or large; in any country, depending on the nature and size of the institution as well as the degree of bribery risk to which it is exposed.

3.4.4.2 Probing Measures

Probing measures are proactive measures that are set to facilitate an effective investigation or auditing process as well as ensure an operative recording and reporting system (Hindess, 2005; World Bank, 2011). The PBM construct came in fourth place with a mean score of 6.50 and eight variables. Because of the clandestine nature of corrupt practices, corruption remains one of the toughest criminal acts to investigate. Unlike other criminal cases, there is no crime scene, no left-over impression, no fingerprints or observers to follow up.

According to Wai (2016), corruption investigations can be categorized into two main variants: (1) probing previous corrupt offenses and (2) present case(s) or investigation(s). The author identified eight fundamental conditions to ensure a very potent corruption investigation procedure: (1) getting acquainted with nature and processes involved in corruption; (2) full investigative authority; (3) adequate resources; (4) freedom from external forces; (5) confidentiality; (6) professionalism; (7) international shared support and (8) effective reporting system. Moreover, a corrupt act transpires or follows the following procedures: weakening or distorting required standards and stipulation of a process; demanding or giving an offer, generally in the form of a bribe; sourcing for the offer (bribe); payment of the offer (bribe) and lastly, disposal or utilization of bribe. These actions stem from or result in abuse of power. The duty of an investigator or a probing agent such as an auditing officer is to gather adequate evidence to prove that the process indicated above has taken place. Therefore, the investigator is required to prove “what,” “who,” “where,” “when,” “why,” and “how” in every case, if possible.

Moreover, there is a need for the investigator to be familiar with adequate probing techniques to be competent and successful (Wai, 2016). The author listed some essential ones based on the ICAC success model. They include aptitude in identifying and tracing the persons behind the corrupt act, the companies and properties involved, good interview techniques and thorough scrutiny of documents. Others include financial investigation, being able to act as an undercover or disguised official, protecting witnesses, and adopting or employing physical and technical surveillance. Different jurisdictions may possess or use different probing or investigative manuals to facilitate the investigation of corruption. For instance, the Anti-Corruption Investigation and Trial Guide (USAID, 2005) in the US, the Asian-Pacific Economic Cooperation (APEC, 2014), the OECD Investigation And Prosecution Of Corruption offenses, the Contract and Procurement Fraud Investigation Guidebook (Piper, 2017), among others. Every strategic and effective anti-corruption tool should encompass comprehensive probing measures to facilitate corruption investigation.

3.4.4.3 Compliance Measures

To comply simply means to act or adhere to stipulated norms, regulations, demands, requests, and principles. The compliance measures' construct was ranked fifth with a mean score of 6.20. It encapsulates five distinct variables, which are contractual compliance, procedural compliance, compliance to code of conduct, adherence to professional standards, and lastly, compliance to fairness and transparent procedures. The development of an anti-corruption framework or policies without necessary compliance measures to check the adherence of the developed framework may render the entire anti-corruption system (framework) ineffective. (Owusu et al., 2017). However, complying with stipulated ACMs appears to be problematic, not only in the literature but also in real life. This is evident in developing countries where there are numerous reported cases of procurement professionals not following the laid-down principles for conducting effective procurement (Osei-Tutu, Badu & Owusu-Manu, 2010; Tabish & Jha, 2011; Zou, 2006). This may be attributed to the assumed psychological and philosophical notions that anti-corruption measures or other ethical and legal structures ought to be followed once developed and enforced.

This concept is sometimes assumed without drawing up practical compliance measures to inform parties on how to comply with the measures and risks involved, should one decide not to consent to the stipulated measures. The compliance measures that were captured in this review include compliance with fairness and transparent procedures, contractual compliance, procedural compliance, compliance to a code of conduct, and adherence to professional standards (Le et al. 2014; Bowen et al. 2012). Worthy, John, and Vannoni (2017) identified five types of public compliance that can be applied in institutions or the private sector: noncompliance, lesser compliance, partial compliance, full compliance, and concordance. These were intended to facilitate or encourage effective compliance with stipulated regulations regarding ACMs. Noncompliance can be regarded as non-adherence to statutory law or regulations of an institution governing the procurement and contractual works. In the case of lesser compliance, an attempt is roughly made to comply with the laid-down laws. Partial compliance offers systematic adherence to the stipulated laws but occasionally occurs in an informal or ad hoc way. Full compliance creates the systems and procedures needed for strict adherence to and observation of legal obligations. Lastly, in concordance, the public and private entities embrace and support the laid-down principles beyond what is required by the law (Burt & Taylor, 2009; Ritcher & Wilson, 2013; Worthy et al., 2017). It is necessary to develop a strategic plan that will aid in establishing an atmosphere of concordance or full compliance. A typical example of a compliance tool is the Anti-Corruption Ethics and Compliance Handbook for Business that was jointly produced by the Secretariats of the OECD, the United Nations Office on Drugs and Crime (UNODC), and World Bank (2013).

3.4.4.4 Regulatory Measures

Regulatory measures refer to stipulated statutory laws, decrees, or acts and institutional regulations developed to prohibit illegal practices and encourage an ethical working atmosphere. It promotes healthy and acceptable relationships among professionals, stakeholders, and developed structures such as working procedures (Bowen et al., 2012; Shan et al. 2015a; Zhang et al., 2016). As a proactive measure, the RGM category recorded the highest mean score of 11.00, placing it first. This means the variables within the RGM construct had relatively higher citations as compared to others. For instance,

"ethical code," one of the RGM variables, had the highest frequency of 24 and "comprehensive rules and regulations" with 14 citations. Other variables within the RGM construct are "the existence of procurement rules and legislation" and "the development of strong political and ethical will to enforce existing anti-corruption policies and laws." TI (2016) defines an ethical code as a set of guiding standards based on moral principles, norms, and central values that influence behavior and conduct in institutions, societies, and government. Morals in this regard refer to how good or bad a person is at differentiating right from wrong (Boyd & Padilla, 2009; Kenny, 2009). An ethical code is deemed to be one of the most important of all the ACMs. Most studies aver that, as a proactive measure, an ethical code represents every institution's framework of dos and don'ts. It represents the primary regulations for how a worker should carry out him/herself, which will auger not only the success of the institution but also protect the moral values and preserve the good name of the institution. An institution without any form of a regulatory framework or ethical code is susceptible to corruption and other unethical practices (Fan, Ho, & Ng, 2001; Sohail & Cavill, 2008). According to Goldie-Scot (2008), it is necessary to reward ethical behavior for constructing a more positive atmosphere in the industry. Not integrating an ethical code as a standard behavioral checker can endanger the existence of an organization or a procurement sector by making it prone to corrupt practices. Although different jurisdictions may have different regulatory measures or legally binding stipulations, the United Nations Convention Against Corruption is the only legally binding universal anti-corruption instrument.

3.4.4.5 Promotional Measures

Promotional measures are described as ACMs designed to propagate or publicize other developed ACMs and strategies to combat corruption in CPM to persons under the influence of the stipulated regulations as well as provide education on the topic of corruption. In other words, PRS can be described as the connecting link between ACMs and the population that is under the influence of the stipulated ACMs. The population involved could be industry professionals, public servants, or to a large extent, the general public. PRS informs professionals and other stakeholders about the preventive (proactive) measures that are already in place and how they are to be observed. PRS also tends to inform parties about the possible punishments (reactive) measures that will be meted out to a culprit who is caught in

corrupt activities. Sichombo et al. (2009) opined that stakeholders need to establish and promote ACMs to mitigate unethical practices and to uphold high standards of ethics in the construction and engineering sectors. With a mean score of 7.88 in the second position, variables under the promotional or advertising construct were considered vital in developing or employing anti-corruption tools in construction project management. This review identified nine different promotional measures (Table 2). They include training and development initiatives, such as the Global Anticorruption Education and Training Project (ACET) (Smith, 2009); raising awareness on incidences of corrupt practices and the probable reactive measures meted out to offenders. Others include educating professionals and the general public about the nature of corruption and the necessary procedures to take in the case of a situation regarding corruption (Alutu, 2007; Tanzi, 1998; Tashjian, 2009). Tabish and Jha (2011) prescribed training as an essential tool to encourage the consciousness of rules and issues concerning ethics among civil servants. According to Doh, Rodriquez, Uhlenbreck, Collins, and Eden (2003), training and development as a single variable is considered a normal extension of the principles and codes of institutions that may aid in responding to costs that are either directly or indirectly related to corruption. Other promotional measures include raising awareness on the general notion and characteristics of corruption through education, workshops, conferences, and so forth (Rebeiz, 2011; Sichombo et al., 2009; Tabish & Jha, 2011). Other promotional factors may relate to specific projects or organizational structures. For instance, disclosing or publicizing vital documents such as contract and implementation details and financial statements pertaining to a project or the public procurement spending on infrastructure projects increases transparency and builds public trust (Le et al., 2014b; Sohail & Cavill, 2008; Suen et al., 2007). Access to such vital information also contributes to an increase in accountability (Hawkins & McKittrick 2012; Ling et al., 2014; Tanzi, 1998). Also, practical tools such as enhanced communication can be adapted to effectively communicate or publicize ACMs internally among top management, employees, and stakeholders, and externally among professional associations (Sohail & Cavill, 2008; Zou, 2006). An example is the Korea Online E-Procurement System (KONEPS), a comprehensive, integrated, end-to-end electronic procurement system that covers the entire cycle of the procurement process electronically (OECD, 2016).

3.4.4.6 Reactive Measures

Reactive measures refer to control mechanisms meted out to culprits or offenders found guilty of committing or engaging in corrupt practices. REM came in the sixth position, with a mean score of 6.00. It was also one of the categories with the fewest composing variables. Depending on the geographical (statutory/institutional) jurisdiction, reactive measures may vary as a result of disparities in the legal structures binding a specific group of people or institutions. For instance, according to the studies of Owusu et al. (2017) and Shan et al. (2017), although developed countries have stricter systems or measures in place to check on corruption, the condition is opposite in the developing world as most countries from the developing world fail to render stern measures to offenders. This is regarded as one of the leading causal instigators of corruption in developing countries such as India (Tabish & Jha, 2011, 2012), China (Le et al., 2014b), Ghana (Osei-Tutu et al. 2010), and Zambia (Sichombo et al., 2009). Moreover, even though under this construct, there are measures such as harsh punishment or penalties debarment/promoting fair debarment procedures and dismissal from employment or other disciplinary actions, their level or degree of enforcement varies from place to place.

No matter the number of proactive measures established and promoted in an organization, some individuals will still take advantage of the secret nature of corruption. Reactive measures are stipulated for these kinds of people. There is a need for effective investigation, and if a party is found culpable, court proceedings or departmental disciplinary action can be arranged, depending on how intense the corrupt action may be (Bowen et al., 2007; Suen et al., 2007; Zou, 2006). Harsh punishment or penalties such as sanctions, criminal conviction (fines and imprisonment), debarment, and other possible punitive measures can be meted out to offenders (Alutu, 2007; Boyd & Padilla, 2009; Shakantu, 2006). Hence, after putting down preventive measures and informing employees of the rights and wrongs and what constitutes corrupt activity, it is expedient that corrective actions be stipulated to serve as checks to reduce the incidence of corrupt acts. These corrective actions may take the form of rendering punishment to culprits, debarring offenders (individuals or institutions) from taking up any further contracts, dismissing the culprits from employment, or other disciplinary actions that are deemed to be

lawful and appropriate. Effective reactive measures are recommended to be in place to ensure proper behavior from employees who may consider getting involved in corruption.

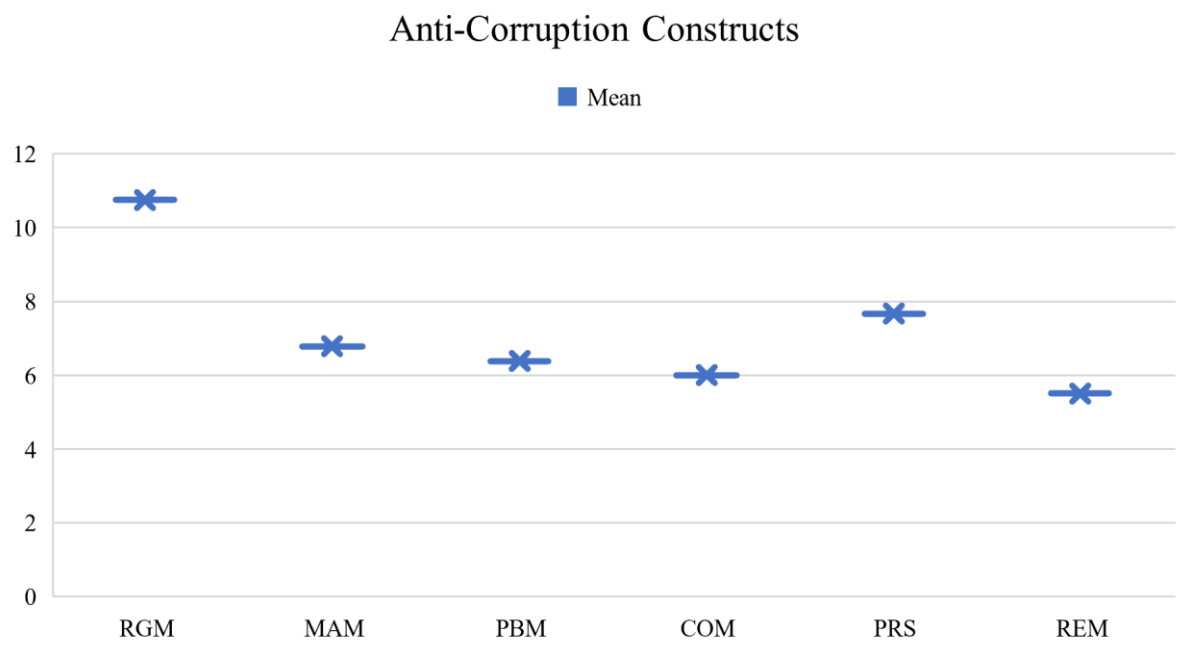


Figure 3.5 Graphical illustration of individual constructs' Mean Scores

3.4.5 Factors Influencing ACM Formulation

Formulating strategic and comprehensive ACMs take several internal and external factors into consideration (Wai, 2006), just as developed models such as the United Nations Convention Against Corruption and Hong Kong's ICAC three-pronged approach, which is globally recognized as a success model, were developed and enforced taking into consideration some internal and external factors (Wai, 2006; Rooke & Wiehen, 1999). Thoughtful and pragmatic consideration should be given to examining external factors such as political, legal, social, and economic environments. Moreover, Owusu et al. (2017) identified more than 40 causes of corruption in construction project management and thematized the variables into legal-specific, psychosocial specific, statutory specific, and organizational-specific causes.

Even though Wai's (2006) suggestions on ACM formulation focus on general corruption (criminology and public-sector corruption), the thematic constructs from the review study of Owusu et al. (2017) in construction project management share a degree of agreement among the areas of focus. Furthermore, internal structures, such as organizational systems, staff, adequate expertise, structure, strategic corporate plan, shared values, and the management style to be adopted, require extensive examination with regard to the development of ACMs.

3.5 Barriers Affecting Effective Application of Anti-Corruption Measures[5]

This section is introduced to explore just a single question, and that is, why are anti-corruption measures intended to help extirpate or mitigate corruption often identified to be ineffective? Corruption continues to be one of the topmost barriers to socioeconomic development and has lived with humanity for the past five millenniums (Noonan 1984). Despite the proliferation of corrupt practices in the public and private sectors which include the procurement and engineering sectors, the needed pragmatic efforts to prevent corrupt practices have been enforced by several public entities and institutions such as procurement boards and authorities in diverse contexts. However, the effectiveness of these measures remains questionable (Shan et al. 2015a; Owusu et al. 2017; Ameyaw et al. 2017).

Anti-corruption measures in this context can be defined as the realistic, systematic, and strategic measures developed, enforced, and applied to mitigate or expunge the pervasiveness of corruption and its detrimental effects in the supply chain of infrastructure procurement and the management of project execution. Numerous studies have reported on the susceptibility of the procurement stages to the incidence of corrupt practices (Tabish and Jha 2011; Le et al. 2014; Locatelli et al. 2017), especially in public infrastructure procurement. Moreover, due to the large sums of monies and resources expended

[5] This chapter is fully or partially published in the following journal article: Owusu, E. K., & Chan, A. P. (2018). Barriers Affecting Effective Application of Anticorruption Measures in Infrastructure Projects: Disparities between Developed and Developing Countries. *ASCE Journal of Management in Engineering*, *35*(1), 04018056.

in infrastructure projects coupled with its complex nature, the procurement process has been tagged as the most vulnerable process to corruption globally (Krishnan 2010; Chan and Owusu 2017; TI 2005).

Right from the conception stage where the requirements of a project are defined through to contract close-out, diverse forms of corrupt practices are recorded, such as clientelism, solicitation, bribery, among others (Chan and Owusu 2017). Researchers and policymakers have contributed immensely towards the investigations of leading topical constructs regarding corruption in construction project management, such as forms and causes of corruption, risk indicators, and anti-corruption measures. This has, therefore contributed tremendously to the body of knowledge concerning corruption research in construction project management.

The developments or formulations of effective anti-corruption measures, therefore, tend to focus on the inferences of the identified constructs. It was somewhat surprising to discover that only a handful of studies that have highlighted or made mention of some barriers that hinder the practical applications of developed and enforced measures without any thorough empirical justifications. Therefore, whereas no empirical investigations on this subject matter are available, 19 studies (**Table 3.8**) have either directly or indirectly pointed out some encountered obstructions that derail the full potency during the enforcement and application of developed measures in diverse contexts. Owusu et al. (2017) and Le et al. (2014) pointed that most enforced anti-corruption measures would have achieved tremendous results should there be appropriate measures to check the barriers that hinder their effectiveness.

The mentioned studies, moreover, recommended that future research should pay critical attention to exploring these barriers as that will contribute to the development of more stringent and strategic ACMs. This section, therefore, presents the critical barriers that obstruct the intended effectiveness of anti-corruption measures developed overtime to mitigate corrupt practices in construction project management. This section primarily contributes to a deepened understanding of corruption research in construction project management, especially under the construct of anti-corruption research. The findings reveal the criticality of the identified barriers and serve as a knowledge base for practitioners,

policymakers, anti-corruption institutions, academic and industrial researchers to incorporate or refer to during the development of anti-corruption measures. Thus, rendering tremendous support to the enhancement of already existing or yet-to-be-developed anti-corruption measures to guide the day to day procurement, execution, and management of construction and other infrastructure-related projects.

3.5.1 Anti-corruption Efforts and Identification of the Barriers

Efforts towards the development of realistic anti-corruption measures are initiated, implemented, and enforced consistently to yield the desired results of mitigating corruption (Shan et al. 2015a). However, one of the many queries raised on the topic of corruption lies in the effectiveness of anti-corruption measures that are developed and enforced to tackle diverse forms of corrupt practices in different contexts (Ameyaw et al. 2017; Le et al. 2014a, b; Owusu et al. 2017). From the perspectives of industrial and academic researchers, some of the anti-corruption measures developed to check corruption in project management include an increase in accountability, comprehensive rules and regulations, effective investigation and court proceedings, departmental disciplinary action and rigorous supervision among many others (Zou 2006; Suen et al. 2007; Tanzi 1998; Shan et al. 2015a, b; Hawkins and McKittrick 2012).

Moreover, the contributions from top global organizations include International Organization for Standardization (ISO) 37001 document, also known as the Anti-bribery management systems (ISO 2016; GIACC 2016), Transparency International's Project Anticorruption System (Boyd and Padilla 2009), FIDIC's Business Integrity Management System for consulting firms among many others (Krishnan 2009; Boyd and Padilla 2009). However, despite the efforts and inputs from all these units, corruption continue to be prevalent in construction and other infrastructure-related projects and their management, especially in the context of the developing world. This is reported to be partly attributed to the factors that impede their full functionality after enforced into effect. Even though not many, the limited number of studies that have been conducted on this subject reveal critical barriers that are worth the need for thorough explorations to come up with means with which they can be thwarted. This is as

well envisioned to facilitate the development of new or strategic modifications of existing anti-corruption measures towards the fight against corruption in construction project management. This section of the review, therefore, intends to commence the discussion and encourages significant contributions in future studies on the topic.

As it may be inferred from the previous section, barriers against the effectiveness of anti-corruption measures in this context can be defined as the hindering factors that impede the effective enforcement or application of the anti-corruption measures that are already in existence and these barriers to an extent. One of the initial studies to report on the barriers in the area of construction management was conducted by Bowen et al. (2012). The study examined the experiences of construction professionals and clients in the South African construction industry. The respondents who participated in the study shared their sentiments on the procedural difficulties in applying the stipulated anti-corruption measures in the South African construction industry, such as reporting of corrupt cases. Among the many recorded and reported barriers included structural and political barriers coupled with a number of psychological constraints, which included an induced fear of victimization, social misrepresentation, fear of being marginalized, social or occupational stigma, and rejection, among many others. Ameyaw et al. (2017) also explored the pervasiveness of corruption in the Ghanaian construction industry, and one of the listed constructs in their study explored the factors that cause prevailing anti-corruption measures to be ineffective. Barriers such as fear of insecurity, which includes fear of losing job, and personal attitude, for example, lack of will to become involved in fighting corruption among others, were identified. Other studies have as well highlighted or reported similar constraints in different contexts. All the identified barriers the valid publications have been summarized and presented in **Table 3.8. Table 3.8,** therefore, presents a total of 17 barriers to effective anti-corruption measures identified in literature after a comprehensive and systematic approach in selecting the needed valid papers as well as extracting the barriers from the retrieved publications. Even though the factors representing the barriers have been captured under this section, a thorough discussion of the constructs and the categorical constructs have been discussed in Chapter 8.

Table 3.5: Barriers to Effective Anti-corruption measures

Code	Barriers	References																		
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
B1	Political and structural barriers.		x	x			x	x	x					x	x	x	x		x	
B2	Fear of insecurity which includes fear of losing job,	x													x					x
B3	Fear of losing life	x																x		
B4	Social misrepresentation,										x									
B5	Fear of being sidelined or marginalized,										x				x					
B6	Fear of being caught reporting,	x					x													
B7	Social or occupational stigma and rejection,										x							x		
B8	Bureaucratic process of reporting corrupt cases,				x						x				x					
B9	Lack of independence										x									
B10	Fear of victimization,										x									
B11	Inappropriate co-ordination of internal structures of an institution/ interagency relation				x								x		x					
B12	Perception of no better end result, distrust in system,						x				x									
B13	The lack of political will by government officials and statutory professional councils to fight corruption.	x			x						x			x	x		x			
B14	Lack of knowledge and understanding of their one's rights within a contractual environment coupled with the difficulty in giving tangible evidence in the event of corrupt activity.										x		x		x					
B15	Inappropriate staffing				x										x					
B16	Lack of knowledge or non-familiarity with ethical codes/ organizational codes of ethics	x				x		x				x			x					
B17	Personal attitude, for example, lack of will to become involved in fighting corruption.	x			x		x			x										

1 = Ameyaw et al. (2017); 2 = Tabish and Jha (2011); 3= Locatelli et al. (2017); 4= Owusu et al. (2017); 5= Chan and Owusu 2017) 6 = Bowen et al. (2007). 7= Zou 2006; 8 = Le et al. (2014); 9= Porter (1993); 10 = Bowen et al (2012); 11= Iyer & Sagheer (2009); 12 = Stansbury (2009); 13 = Osei-Tutu et al (2010); 14 = Shan et al. (2015a); 15 = Shan et al. (2017); 16 = Sohail and Cavill (2008); 17 = Krishnan (2009); 18 = Tidey (2013); 19 = Alutu (2007).
Note: Further details to the references have been presented at the appendix section

3.6 Regional Perspectives of Corruption: The Developing and The Developed Contexts[6]

Explicitly, there are disparities across different cultures when we consider the happenings and outcomes of the variables identified, and the underlying categories developed. Whereas many European countries have stricter anti-corruption measures with corresponding enforcing strategies to deal with the causal factors identified, other regions such as the Middle East, some parts of Asia, and Africa struggle to enforce strict ACMs to deal with these factors. Hence, these causal variables are still reported to be pressing in the regions mentioned. For instance, Le et al. (2014b) conducted a study investigating the causal relationships between the instigation of corruption and the risk indicators of corruption in the Chinese public construction sector. They reported that the most pressing causal construct that fuels corrupt practices in the Chinese region has to do with regulatory-specific causes. Nguyen and Chileshe (2015), also pointed out that corruption (basically PSC) was one of the leading factors of project failures in Vietnam.

In Africa, Bowen et al. (2012) reported the leading causes of corruption in the South African construction industry are lack of transparency in the award of public contracts and also lack of a positive operating environment. Other leading forces that the authors reported had to do with the barriers that impeded the effective reporting of corruption cases. This factor is reported by other studies focused on developing countries such as Ghana Osei-Tutu et al. (2010), Zambia Sichombo et al. (2009), and other investigations. It should be emphasized that different cultures reveal different patterns of causal mappings as well as measures adopted to tackle these issues. In developed countries such as Singapore, The USA, UK and cities like Hong Kong, corruption in CPM is somewhat checked by measures or systems such as e-procurement, raising awareness, rigorous technical auditing system, contract

[6] This chapter is fully or partially published in the following journal article: Owusu, E. K., Chan, A. P., Ameyaw, E. E., & Robert, O. K. (2020). Evaluating the Effectiveness of Strategies for Extirpating Corrupt Practices in Infrastructure Project Procurement. *ASCE Journal of Infrastructure Systems, Ref.: ISENG-1519R5*. (in press)

monitoring, comprehensive rules and regulations, education, access to information, stringent supervision among others (de Jong et al. 2009; Le et al. 2014a, b; Tabish and Jha 2012; Zou 2006; Vaidya et al. 2006; Neupane et al., 2014). Particularly, Hong Kong, one of the world's finest cities, has gone a long way in dealing with corruption and has made tremendous efforts in its fight against corruption in CPM. The establishment of ICAC in 1974 revealed that Hong Kong.

3.6.1 Developing Countries – Ghana as a Case Study

The issue of corruption in the developing context is not only reported in the extant literature and reports but also evident in everyday life of the societies, people, and the public projects within this context (Le et al. 2015; Ameyaw et al. 2017). The problem of poor administration or misappropriation of government funds – corruption – has been very pervasive in emerging economies due to several causal mechanisms, also referred to financial irregularities (Bardhan 2006; Doig, 2012; Tabish and Jha, 2011). Over the years, the country has seen misappropriation of public funds due to the presence of irregularities presented in this chapter. These amounts are intended to be directed to the development of public infrastructure, social amenities, education, among many others. However, either less or no practical efforts have been taken to annul these unprecedented misfortunes.

In the Ghanaian public sector, some of the impacts of the prevalence of these irregularities or corruption indicators experienced are stifled and abandoned projects, late delivery of projects, the use of cheap inferior materials leading to the execution of construction projects of low-quality standard, etc. (Osei-Tutu et al., 2009). There is an increasing consensus that one of the key impediments in public administration of developing countries for the effective socioeconomic service delivery is corruption (Vian et al., 2012; Svensson, 2005). Governments and donors have therefore responded to this menace thwarting their growth and development with a comprehensive range of interventions aimed at strengthening accountability in the public sector (Bardhan, 2006; Rose-Ackerman, 2005) and Ghana is no exception. Specifically, in the public sector, the Attorney-General (A-G) of Ghana is vested with the power to conduct effective audits of government enterprises partly to determine the causal factors

triggering the incidence of corruption in the country. These audits performed by the A-G reveals the irregularities prevalent in the public sector and are reported in the Ghana Audit reports. The irregularities are reported by Tabish and Jha (2011) and Le et al. (2014) as the indicators of corruption in the public sectors. They, therefore, need immediate attention, and elimination once detected because they negatively affect the administration of public funds and lead to misappropriation of the funds. However, no research study to date has systematically assessed these causal measures that trigger the misappropriation of the public funds, the impact on the economy and public administration as well as the solution measures needed to thwart or hopefully curb these financial irregularities in the Ghanaian public sector. This section of chapter four fills that gap by assessing procurement and contractual irregularities that trigger the misuse of public funds, determining the legal measures and other regulations in place, and lastly, recommending measures aimed at curbing the incidence of financial irregularities in the Ghanaian public sector. The areas identified with the incidences of the irregularities are therefore skewed towards public financial records of the public departments, ministries, public agencies, corporations, boards and other institutions of the State in their procurement and contractual works.

3.6.1.1 Defining Corruption in the Ghanaian Context

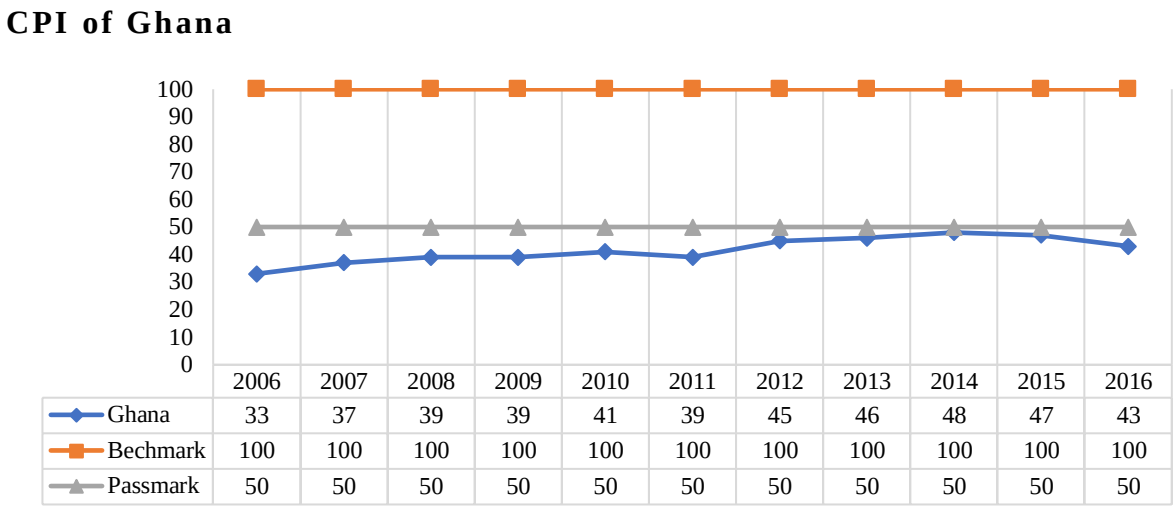
Corruption exists in several forms and shapes and triggered by many causal factors (Tanzi, 1995; de Jong, 2009; Shan, 2015). For instance, while TI (2017) identifies the following forms of corruption: bribery, collusion, conflict of interest, embezzlement, nepotism, etc. prevalent in most public sectors, other studies such as Le et al. (2014); Søreide (2002); Stansbury (2009) have also identified several causal instigators identified in most sectors such as the procurement and construction sectors. Gupta et al. (2002) there is a reported increase in poverty and income disparity as a result of the presence of corrupt practices in the public sector. Identified by Dreher et al. (2007), the adverse effects which are observed as a result of corruption on the global economy are: stifled investments, reduced services provision, increased disparity, truncated economic growth, and others. Shah (2011) blames corruption as both the leading cause and the outcome of global poverty. This unethical behavior is experienced at all levels of the general public, and the only causal effect it leaves behind is extreme poverty on the side

of citizens. Just as opined by NACAP (2011) and Osei-Tutu et al. (2009), the endemicity of corruption in the Ghanaian context emanates from history and has been a severe setback to the country's political and socio-economic advancement since 1957's independence.

The severity of corruption in Ghana in both private and public sectors is owed to its secretive and ubiquitous nature and the ability of permeate in every economic sector (NACAP, 2011) even though Section 239 of Act 29, also referred to as the Criminal Offences Act, prescribes it. Several reports have indicated the pervasiveness of corruption in the Ghanaian public sector. From international bodies to local reports and empirical surveys. For instance, as of the year 2005, a study conducted by GII showed that 90% of the respondents considered corruption to be a far-reaching problem in Ghana whiles 92.5% believe that corruption is highly rampant in Ghana. On the international scale, the World's Bank Country Policy and Institutional Assessment (CPIA) on transparency, accountability, and corruption in the public-sector rating concur with similar findings. For the sake of explicit clarifications, the performance of Ghana's corruption perception index by Transparency International is briefly discussed below.

3.6.1.2 Ghana's Performance on the Global Scale

According to TI (2017), there is not a single country that got closer to the perfect score that represents the corruption perception index of the just-ended year 2016. This applies to the case of Ghana. Over the years, Transparency International, a world-renowned anti-corruption agency, conducts a global survey to assess the performance of world economies regarding corruption perception. **Fig. 3.7** indicates Ghana's performance over the past decade.



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Ghana	33	37	39	39	41	39	45	46	48	47	43
Bechmark	100	100	100	100	100	100	100	100	100	100	100
Passmark	50	50	50	50	50	50	50	50	50	50	50

Figure 3.6 CPI of Ghana for the past decade (Adapted from TI, 2017)

Fig. 3.7 presents the performance of Ghana between 2006-2016. Comparing this data to the previous year is not later than 2006, it was identified that Ghana had improved in the global ranking. However, to date, Ghana cannot be considered as a clean country per the results of TI simply because there has never been a moment that the country attained a score of more than 50, which represents the pass mark. Countries found within the region of 50-100 are regarded as clean countries, and per the latest results released by TI (2017), 54 out of 176 countries are ranging from Denmark, 1st, to Slovakia, 54th were captured in the clean region. This indicates that per the number of countries identified by TI, only 30.68% lies in the clean region.

However, it should be realized that even among the 30.68%, not all of them are regarded as very clean. This indicates how challenging corruption is in the global context. Ghana attained a score of 43 in the most recent ranking, obtaining a position of 70 out of 170 countries. There was a drop of 4 points as compared to 2015 results. The performance of Ghana with regards to corruption on the global market is a direct reflection of the irregularities or corruption indicators identified by the A-G over the years. Ghana's public sector has been hit with plagues of corruption cases to the point that the executive opinion survey conducted by the World Economic Forum (WEF, 2016) identified corruption as the second most problematic factor for conducting business in Ghana. Moreover, although there are both

direct and indirect causal factors that instigate or propels the incidence of corruption in the public sector, the A-G stipulates that the irregularities identified and reported over the years represent direct indicators or corrupt practices. Therefore, drawing and enforcing proactive and reactive measures taking these irregularities into consideration are deemed necessary to thwart the frequent occurrence of corrupt practices in the short term and annul its incidence in the long term. Many efforts have been given by successive governments to strengthen and safeguard public sectors from corruption since the attainment of independence till date.

Fig. 3.8 and 3.9 also highlight Ghana's performance in Worldwide Governance Indicators (WGI), Corruption Control, and GCI on Government Integrity by the World Bank and the World Economic Forum, respectively. Per the indications read from both graphs, Ghana has been within the range of 50-60 for WGI on corruption control and 30-48 for GCI on government integrity, which has not been that encouraging. The years from 2013 to 2016 saw a steady rise in performance on government's integrity which measures corruption, the massive decline from 48 (Ghana's best score over the two decades) to 35.5, does not depict a sign of any real hope for the future. Ghana, however, has never achieved the pass mark of 50 and above for the past two decades, which partly demonstrates poor public administration regarding government's integrity. The case shown by WGI on corruption control is quite similar to the first instance. There is, therefore, the need for long-term practical measures to be put in place to check the irregularities or corruption instigators prevalent in the country.

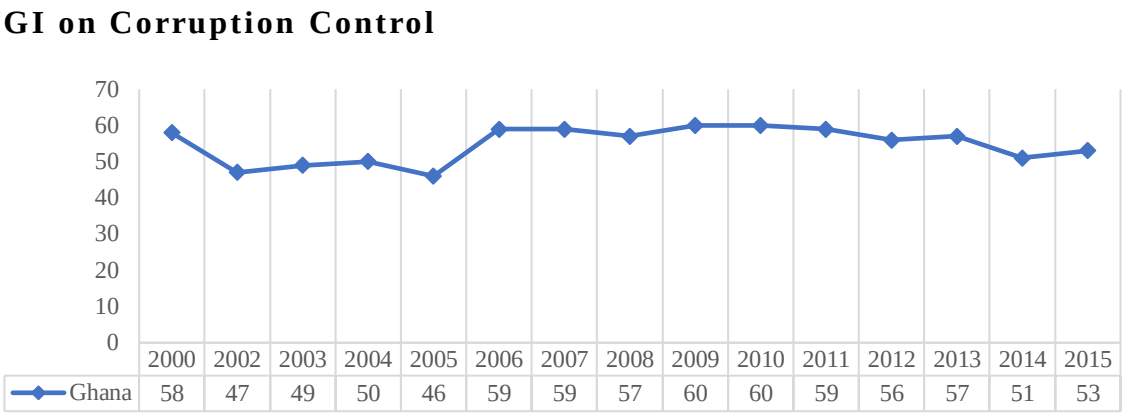


Figure 3.7: Worldwide Governance Indicators, (WGI) on Corruption Control

Source: World Bank (2016)

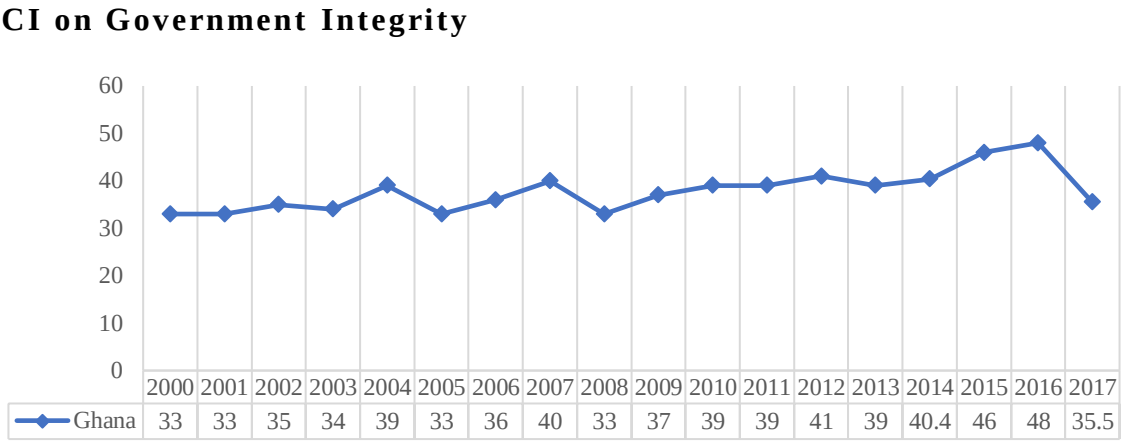


Figure 3.8: Global Competitiveness Index (GCI) on Government Integrity

Source: World Economic Forum (2017)

3.6.1.3 Decadal Point Interventions

The government of Ghana has set not only several legal frameworks and structures to mitigate corruption within the public sectors in place but also the private sectors as well. The framework below depicts the legal structures in the form of acts, legislation, and policies set by successive governments since the independence of Ghana. The interventions are stipulated and illustrated in decadal periods as presented in **Fig. 3.10**. Further explications to their fight against corruption in their respective designated areas are presented after the illustrations. The framework was adapted from A-G Reports used for this review and also from NACAP (2011) Global Insight (2016); Constitution (1992); Osei-Tutu et al. (2009).

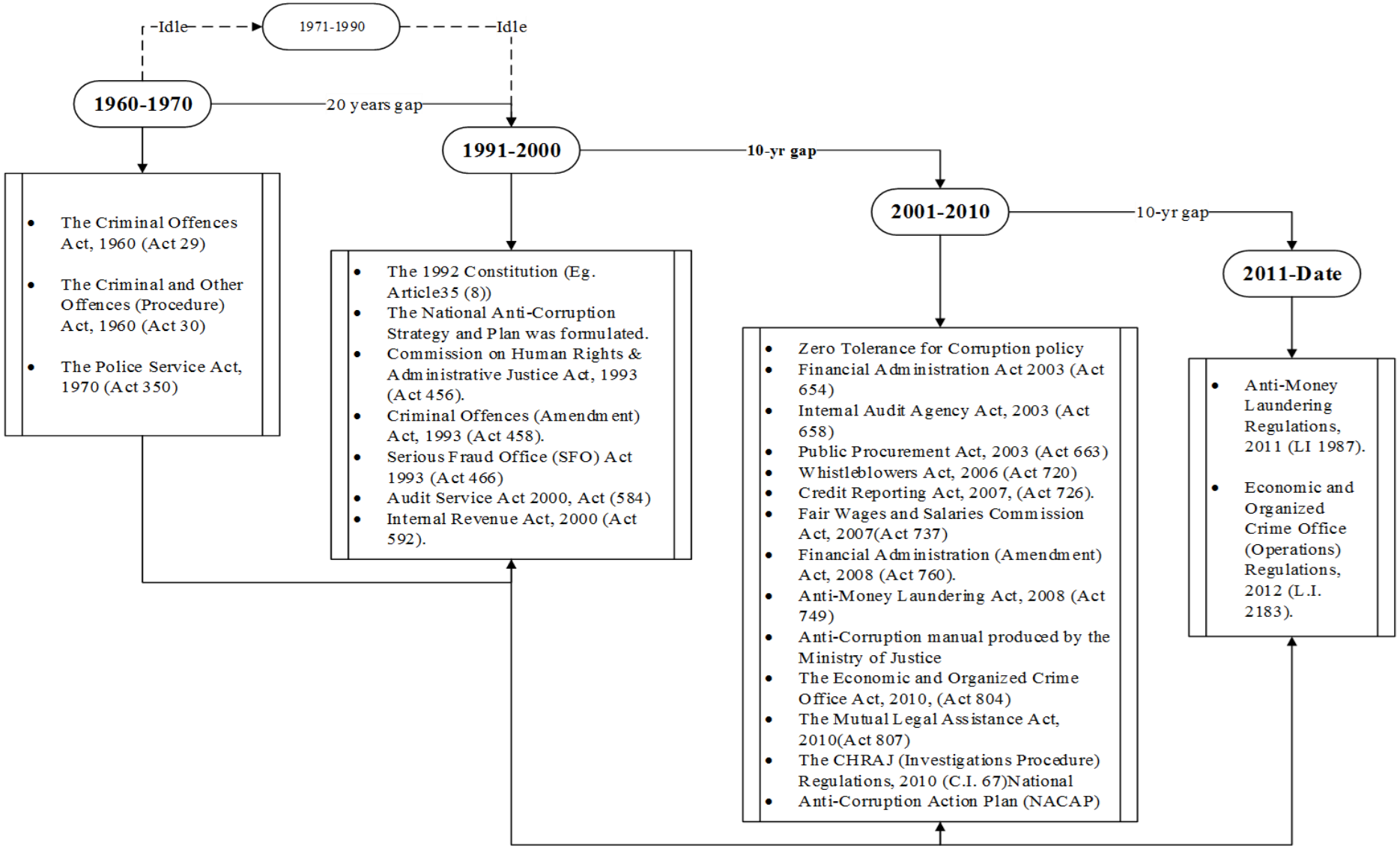


Figure 3.9: Decadal Efforts on Legal Anti-Corruption Frameworks.
Source: Owusu et al. (2020)

The effect of these legal provisions is to create the foundation from which the anti-corruption fight can be developed. To fulfill these constitutional provisions, the State, through the legislature, has enacted various pieces of legislation to combat corrupt activities of any form.

3.6.1.4 Corruption in Public Projects

In Ghana, corruption has been noted as a key impediment to the successful completion of vital public projects. For instance, Ameyaw and Chan (2015) identified corruption the second most critical risk indicator against public-private partnership (PPP) water projects in Ghana. A similar study conducted by Osei-Kyei and Chan (2017) also revealed corruption to be the topmost risk indicator to PPP projects in Ghana. The list goes on and on as Damoah and Kumi (2018) recently reporting corruption to be one of the vital contributors to public project failure. The issue of corruption in the developing context, particularly in Ghana, has always been on the rise with limited efforts expended in exploring this menace can be tackled. The explorations of the negative constructs are mostly conducted to reaffirm the notion or supposition that corruption is prevalent in the developing context. Lastly, with limited efforts expended on how to address the ineffectiveness of ACMs, the significant relationship of the factors causing the ineffectiveness of the existing ACMs are yet to be explored not only in the developing context but also within the scholarship of corruption-related studies in public projects.

3.6.1.5 Irregularities in Public Project Procurement

Government procurement has been one area of attack regarding corruption (Ateljevic and Budak, 2010). Krishnan (2010), Soreide (2002), and Transparency International (2005) reported that public procurement on the global scale stands to be the sector that is most prone to corruption. Simply put, the tendency for corrupt practices to occur at any stage of the procurement process is extremely high as compared to other sectors and industry such as the manufacturing sector. According to Tabish and Jha (2011), Public Procurement encompasses all the outsourcing activities of a state or a government. In other words, it includes the overall process of purchasing or acquiring goods, works, and services by the government (Thai, 2008; Tabish and Jha, 2011).

The stages may include the procurement planning stage, the preparation, and processing of procurement requests, which includes carrying out a market survey or research. Other stages include the development and review of requirements documents, planning for the evaluation, or tender assessment stage through to the awarding contract to the successful bidder to the signing of contract and administration of the contract. The processes involved in a typical public procurement may include more comprehensive stages than what has been stipulated above. Due to the complexities of the stages as well as the number of parties involved, the whole process gets exposed to corrupt practices. Contract irregularities can be referred to as corruption indicators or anomalies peculiar to contractual negotiations and processes. Most governments face similar challenges when it comes to procuring infrastructure or construction works (Tabish and Jha, 2011). **Table 3.9** stipulates the irregularities identified in procurement works.

Table 3.6: Irregularities in Procurement

		REFERENCES (REPORTS)											
No.	**Irregularities**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	Institutions not following correctly the Public Procurement Act regarding obtaining minimum quotations, exceeding authorized threshold limits and unauthorized sole sourcing of suppliers.	√			√			√	√	√		√	√
2	Lack of adequate supervisory control over procurement transactions and management					√		√	√				
3	Payments for uncompleted works			√			√			√		√	
4	Non-application of sanctions									√			
5	Poor supervision of subordinate officers									√			
6	Disregard for Public Procurement Act regulations							√					
7	Procurements not taken on ledger charge			√		√				√			
8	The procurement of goods and services by the administration without adequate recourse to procurements committees of the various public institutions, which diverges from the provided regulations.										√		√
9	Variations to contract									√			
10	Outstanding mobilization advances owing to non-observance of stipulated regulations						√						
11	Fragmentary procurement								√				
12	Little evidence of value for money spent		√		√			√				√	
13	Sourcing of proforma invoices from the same supplier (Single sourcing)								√				
14	Overpayment of purchases		√						√				
15	Lack of proper coordination among the major departments of the Company and apparent internal control weaknesses reconciliation on Association									√			
16	Lack of consistent monitoring and review of procurement activities	√											
17	Lack of whole-of-government and corporate procurement planning for significant purchases	√											
18	Lack of audit trails or verification data				√	√				√			

3.6.1.6 Explicating the Findings on Procurement Irregularities

Table 3.9 provides an overview of financial irregularities recorded by the A-G of Ghana over the last decade. These irregularities are regarded as the indicators of corruption by Tabish and Jha (2011) and Le et al., (2014). As recorded in some countries and institutions, the prevalence of these irregularities is very noticeable in developing countries (Ivanyna and Shah, 2011). Moreover, that has been one of the most significant impediments to growth as well as infrastructure and other vital developments. The occurrence of this situation evolves and revolves around these irregularities identified but uncared for. These practices do not only crop up financial drain in the public sector but tarnish the image of the economy as well.

Most of the reports stressed out on the issue of public officials ignoring the application of the required stipulations set by law to rather conduct procurement in a manner that will benefit them. This has been the peril of not only Ghana but other developing countries such as Nigeria (Alutu, 2007; Alutu and Udhawuve, 2009), India (Tabish and Jha, 2011), Zambia (Sichombo et al., 2009) and many others. Another causal factor that enables these incidents to flourish is owed to the anti-corruption agencies who are not connected to governmental projects to scrutinize the whole procurement process. Since most of the powers have been vested in the procurement board, top officials of the board may abuse their powers by manipulating the entire procurement process. This cripple the administration of the entire procurement process since these are the same officials who top administrative positions. Moreover, it indicates the vulnerability of the country to corrupt practices and adversely leaves the whole administrative system flawed. (Doig, 2012; Schatz, 2013; Sööt and Rootalu, 2012).

The audit service of Ghana examines part of their duties and only reports some of these irregularities to which in most cases. However, nothing is done about it, so they are left to report the same events and incidents over and over again, and that was identified in the reports. Again, since most of the audit officials may not be conversant with the procurement process, they are left to report superficial but not in-depth cases owing to the non-palpability of their mode of examination. Kenny (2009) indicated that audits performed by professionals with the appropriate expertise or background yields better and quality

results. Therefore, in this case, it will be apropos for the audit in the procurement sectors be undertaken by an auditor with a professional procurement background. Uncompleted works are also paid for without any proper examination of work progress. When culprits are found breaking the regulations stipulated in the Public Procurement Act (PPA), no equal sanctions are meted out to them. This encourages young public officials follow the same footprints with the notion that those unethical practices are the activities of the day and has therefore been mended into the institutional culture of public offices. Public officials as well purchase items in the name of the government yet unable to provide full proof of receipt of purchased items, and in most cases, very little evidence of value for money spent is given. These are all irregularities detailed out in the assessed reports. Lastly, on the procurement process, identified as part of the irregularities is the absence of proper coordination among the major members of the departments as well as the apparent weakness of internal control. Probably the worst of it all but not the most important per the frequency of the irregularities. It is a negative practice considering the numerous instances of disrespect and disregard for rules by public officials who have gone through vetting and have acclaimed to hold in high esteem the norms, values, and regulations of the country. No sanctions are, however, meted out to these culprits; no public enforcement body makes sure they are brought to disciplinary actions. These are just a few of all the irregularities and corruption instigators identified among the various procurement units of public enterprises as addressed by the AG since the last decade.

3.6.1.7 Recommendations by the A-G

In almost all the reports, the A-G suggested that strict adherence to the provisions of the Public Procurement Act, 2003 (Act 663) to ensure value for money in contract management. This statement has been persistent in almost all the reports reviewed. As a government challenge, there are many governments or countries to learn from at the initial stages of dealing with these irregularities such as Hong Kong, Singapore, Australia, the United Kingdom, etc. These cities and countries have been able to check these irregularities, which most often appeared as indicators and instigators of corruption, and pragmatic steps were taken to mitigate their occurrences. For instance, according to studies such as Lo, (2001), Cheung (2008), De Speville (2010), etc. Hong Kong (HK) was faced with diverse kinds of

corruption cases, which included some of the irregularities identified in this review. However, practical measures such as the establishment of the HK ICAC with full autonomy to investigate corrupt cases, identify the prevailing irregularities, develop a solution, etc. were established in 1974. Decades down the road until today, Hong Kong is applauded for the massive efforts taken to mitigate corruption. The same has been done in the geographical locations mentioned above, and according to the studies of De Speville (2010), Botswana which is regarded as the cleanest country in Africa in terms of TI's corruption perception (TI, 2017), adopted the same strategy as HK did. The Directorate on Corruption and Economic Crime (DCEC) was established in 1994 to deal with the same causal factors identified. However, before the establishment of the DCEC, Botswana was regarded as one of the most corrupt countries in the developing world. Adopting the same pragmatic measures, which include investigation, education, and enforcement, Botswana has been able to check the level of corruption and now regarded as one of the clean countries in the world. The difficulty encountered here is not with regards to the adoption, but the processes involved in the adoption of such schemes and frameworks. The fight against corruption may seem difficult, but it is still possible. Several countries and economies have proven it with active research, the establishment of anti-corruption bodies, development of strategic anti-corruption measures, and others to deal with this social canker.

Owing to the identification of these causal measures, better strategic measures can be developed specifically to deal with these irregularities. Moreover, as Henry (2009); de Jong et al. (2009) asserted, the fight against corruption should be a collective action of individuals, anti-corruption institutions, policymakers, etc. except the corrupt and should not be a lone battle left to some few to deal with it. It is until corruption is checked to a point where it has less influence on the economy that both the economy and the inhabitants thereof can fully enjoy the nation's economic resources, active infrastructure development, and economic growth. Just as NACAP (2011) insinuated, the control of corruption in Ghana should be the responsibility of each citizen. By this contribution, citizens are allowed to join hands and tackle corruption in the country to secure and sustain the nation's development. The question is, how the populates join hands if they are ignorant of the true meaning of

what they are going to deal with. From the findings, corruption is rather seen as a more technical, secretive, and well-calculated menace that may take the expert to identify.

3.6.1.8 Section Summary

This section sought to review the annual audit reports as well as some relevant literature on Ghana to determine the causal measures behind the irregularities identified in the procurement and contract works undertaken by the public sectors (also identified as corruption indicators). With the aim of this section scoping in on the irregularities involved in procurements and contracts, the other areas which include taxes, loans, payroll and rent need may need to be addressed by other or further studies. The prevention of public funds misappropriation and irregularities concerning procurement remains one of the most vital importance to every economy due to the high negative impact on governments. Previous studies, for example, Doree (2004), Tabish and Jha (2011), Krishnan (2010) reported that to check the happenings of these irregularities, there is the need for curative measures to be put in place such as accountability, transparency and reactive measures such as punishments for offenders. However, these problems cannot be fully tackled when these corrective measures are applied in isolation since these irregularities occur in different forms and formats.

3.7 Developed Countries [7]

3.7.1 The Case of Hong Kong

Unlike the case of most countries in the developing context, notable disparities between the two contexts show that most countries in the developed countries perform better in the fight against corruption as compared to the developing countries. In this section, Hong Kong is used as the case study. The past four to five decades, Hong Kong has been phenomenal regarding the city's dealings against corrupt practices (Gong et al., 2015; Moran, 1999). Just like an incurable disease, it is possible to treat

[7] This chapter is fully or partially published in the following journal monograph: Owusu, Emmanuel Kingsford, and Albert PC Chan. "Corruption in Infrastructure Procurement: Addressing the Dynamic Criticalities." (2020). Taylor and Francis.

corruption to the barest minimum level but difficult to eliminate. This statement is evident in the continual assessment of the corruption perception in all the countries in this world (Wong, 2010; Mo, 2001). No country in this world stands perfectly against the happenings of corruption. Even Denmark, which happens to be the cleanest country in this world according to TI (2017), is not regarded as 100 percent clean because corrupt people will continually exist because of greed, selfishness, and the lewdness in a person's heart. Therefore, in as much as there are various formulations and developments of anti-corruption measures, models, and frameworks, there is the need for psychological and moral foundations of combatting corruption in every sector of the local government. However, that is not always the case.

Hong Kong has made bold and pragmatic progressions to dealing with the menace of corruption over the past 40 years and still moving forward (De Speville, 2010; Quah, 2013). Other countries and institutions have adapted their strategy as well as their modus operandi in dealing with individual cases, some are in the pipeline of adopting, and others are yet to adopt (Li, 2004; De Speville, 2010; Gong and Wang, 2013). This has led to the constant increase in the performance and international rankings over the years until 2012 to 2015, which recorded a series of decline. Numerous studies conducted on this subject matter have led to interesting findings, which are discussed later in this section. Since no study has presently reviewed the overview and characteristics of corruption in the Hong Kong context, this section presents a thorough examination of corruption in the Hong Kong context.

The findings of this section contribute to a deepened understanding of the dynamics of corruption in Hong Kong and how emerging economies can learn from. Not only policymakers and anti-corruption institutions but also law enforcement agencies and researchers in developing strategic measures would find them useful in dealing with the menace of corruption in our economies. This section serves as an essential premise for further empirical studies presented later in this study.

3.7.1.1 Topical Coverage of HK Publications

As noted in the previous sections, the retrieved papers discussed a broad range of topics from both the private and public domains highlighting on the issues of the control and efforts taken by the Hong Kong Special Administrative Region (SAR) on the issue of corruption. Other topics cover business and the rule of law, the ethical concerns, how other institutions and countries can emulate HK in their pragmatic and consistent efforts. The comparative analysis of HK and other countries and well as HK's international corporations, and lastly, the concerns of the populate on the matter of corruption were the final topics captured in the review. The frequency of these topics over the years is illustrated in **Fig. 3.11.**

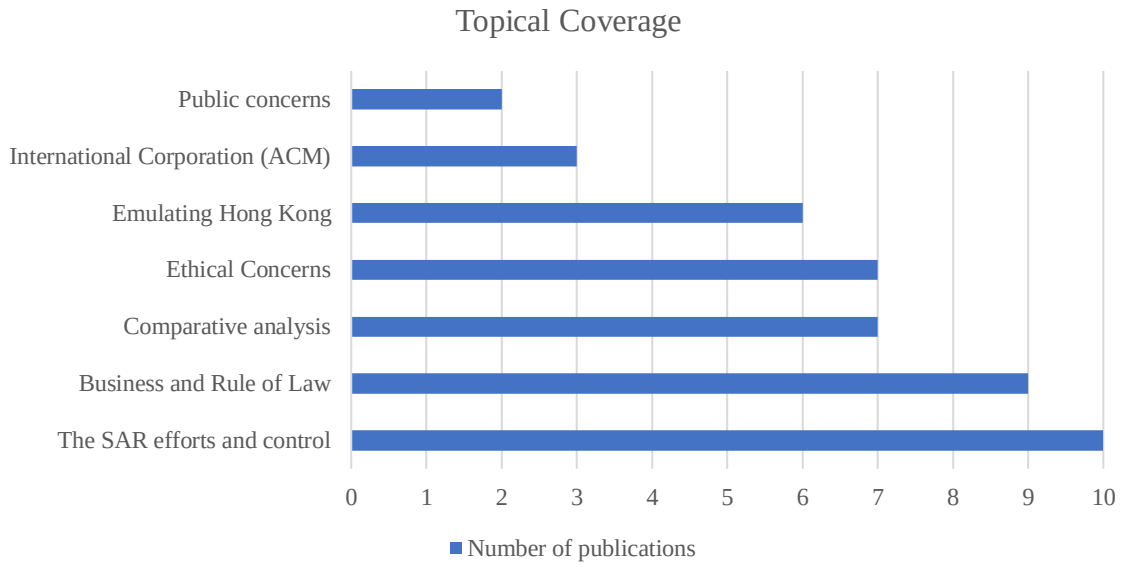


Figure 3.10: Topical coverage of corruption-related studies of Hong Kong

Fig. 3.11 depicts the topical indexes of the 44 retrieved papers. Ranging from the least to the most discussed theme, constitute public concerns and SAR efforts and control respectively. The SAR efforts and control. It was not a surprising outcome to note SAR efforts and control construct as the topical area with the highest frequency. Obtaining a total number of ten papers, most scholars seem to have covered interesting issues on the efforts instigated by the HK SAR to control and maintain a less corrupt society. For instance, Lo (1999) reported on HK's experience on minimizing corruption and crime rates from the years 1950 to the early '70s, where the condition of the State was a purely autocratic colony

and a government-driven by business, which looked down on the citizenry. Corrupt activities were culturally rampant, and the order of the day among senior public officials in the early years, and they stemmed from Mainland China (Lo, 1999). However, HK began to see a turnaround in the middle ages of 1970 to the '90s, which is still in effect until today. The mid ages were the times that the State of HK was very determined to combat the 'political-criminal nexus', and this led to the formation of one of the most vibrant and effective anti-corruption institutions in the world today known as the Independent Commission Against Corruption (ICAC). As an absolute independent structure, the ICAC has led HK to such pragmatic efforts and fight against corruption due to the following characteristics: adoption of a three-pronged attack approach, which is discussed later in this section; substantial remuneration to sustain integrity; performance of integrity checks; draconian powers to conduct effective investigations, etc. (Lo, 1999; Moran, 1999; Lo, 2001). Some major forms of corruption that the ICAC has dealt with to date include bribery as well as other trans-border crimes, which included counterfeiting, money laundering, smuggling, and fraud (Moran, 1999). Lastly, per the study of Moran (1999), other variables that have aided HK's efforts in the fight and control against corruption lies in the power balance within the political economy, the rule of law, state's capacity, etc.

3.7.1.1.1 Business and the Rule of Law

Business and Law as the second leading subject for this review encapsulates not only the corrupt practices identified under this construct but also the fairness of business transactions and the efficiency of the legal system in HK. Lee (1995) highlighted that the impartial and efficient legal system of Hong Kong had been one of the primary drivers for economic success in HK, as well as led to thwarting corrupt activities in the Special Administrative Region (SAR). Lee's study drew strong emphasis on the preservation of HK's firm foundation of the legal system and how it had been protected from the Chinese government due to the endemic nature of corruption that was present in China as of that time. This legacy of the firm support of the rule of law in HK has contributed enormously to what the world praises HK for. On the premise of business and economic growth, Mo (2001) estimated that a 1% rise in corrupt practices tends to cause a deficit of 0.72% in a nation's growth rate. Moreover, political instability connotes the channel through which corruption can severely attack economic growth. Given

this background, HK has stood on the grounds to combat any infiltration and determinants of economic and political instability from other countries, maintaining a competitive business state as well as a State where the rule of laws applies (Mo, 2001; Lo and Ngan, 2009). Lastly, Lee (2016), identified that foreign capital could serve as a measure to reduce the incidences of corruption in provincial governments.

3.7.1.1.2 Ethical Concerns

Ethics, regarded as moral principles that guide the behavior or how a person should conduct himself, has been one of the principal concerns of HK. Several findings have evolved from the studies conducted so far. For instance, Ho and Redfern (2010); Snell and Herndon (2000); Donleavy et al. (2008); Scott and Leung (2012). There have been several developments of ethical codes during the colonial as well as the post-colonial era (Ho and Redfern, 2010). In the pipeline of attaining independence from the British in 1997, the people of Hong Kong feared that there was a possibility of the return of corrupt practices (Snell, 1999). Owing to bribery reports noted in the HK-Mainland cross-border trade, many were concerned with the achievements of ICAC coming into ruin (Snell, 1999; Donleavy et al., 2008). To maintain the healthy ethical culture, ICAC organized a conference in 1994 on business ethics and urged HK companies to adopt ethical codes in their day to day modus operandi and this practice has been in place to this present day (Snell et al., 1999).

Per the study of Luk (2012), the topic and the concerns of ethical culture have, in recent years, become more vital in public administration and the government of HK is no exception. However, due to the pragmatic efforts in maintaining an ethical society, HK has been internationally recognized as one of the least bureaucratic and corrupt governments in the world, although they still face some challenges. HKSAR adopts a four-way approach in developing ethical practices in the civil service according to the study of Luk (2012), and they include prevention, education, sanction and lastly, help from government departments and other agencies. The Public Service (PS) (Administration) Order, as well as the PS Disciplinary Regulation, provide a very firm and strong disciplinary action in the case of serious misbehaviors committed by officers. Although HK enjoys a serene ethical atmosphere, it also faces

challenges such as, the ethical dilemma (when a person finds it difficult to adjust to organizational ethics due to family background, educational factors, and religious beliefs), the conversion of ethical norms (abstract values) into ethical actions (practical actions), the ineffectiveness of some moral mechanisms etc. (Donleavy, et al., 2008; Ho and Redfern, 2010; Scott and Leung, 2012). All these problems need to be empirically addressed in detail to enhance the ethical culture of HK.

3.7.1.1.3 Emulating Hong Kong

As a model city that has proven beyond all reasonable doubt that corruption can strategically be dealt with, HK has become one of the cities in the world whose strategies are worth adopting, whether for organizations or governments. However, the question raised here is, is it possible to be adopted by every state or country, institution, etc.? Quite a number of literature has dealt with this issue (de Speville, 2010; Cheung, 2008). Per the review conducted, emulating HK construct happens to be the 5th most discussed topic. Although the strategies of HK are worth adopting, what are some of the streamlined processes and paths to be followed? Most of these papers explicated how China could adopt HK's effective model in eliminating corruption (Cheung, 2008; Mao, 2013; Hira, 2016).

Mao et al. (2010) assessed the generalizability of HK's ICAC strategy in the Chinese context. Countries such as Botswana and Madagascar have adopted ICAC's strategies in fighting corruption and have made significant progress (de Speville, 2010). For instance, the Directorate on Corruption and Economic Crime (DCEC) of Botswana formulated their anti-corruption model by adapting that of ICAC with some adjustments, and they remain the cleanest country in Africa and forms part of the top 25% most decent countries in the world regarding corruption (TI, 2017). There have been several scholarly objections to the replication of HK's solution in other countries, such as the uniqueness of corruption cases in the context of Hong Kong and the high cost involved in the establishment and maintenance of an anti-corruption institution. Others include the intensity of the remedial measures adopted by ICAC is described to be dangerous to be applied in another place; and lastly, the frontal attack on the notion of establishing an anti-corruption institution as a medium of fighting corruption. De Speville (2010), however, concluded that the answer to these objections lies in policy and governance reform. This was

what happened in the case of Botswana to make it what it is today. Some of the measures that can be adopted include an explicit, logical and a comprehensive strategy by a well-established anti-corruption body, skilled and trustworthy personnel, community involvement, confidentiality, protective listening, prevention, and education, investigating and disposing of complaints and lastly measuring progress (de Speville, 2010; Li, 2004; Cheung, 2008; Gong and Wang, 2013; Mao et al., 2013; Hira, 2016).

3.7.1.1.4 Comparative analysis

Corruption measurements and comparisons are regarded necessary since it encourages fewer performing countries or institutions to march up to good or appreciable standards in fighting corruption. Comparatively, HK ranks 15th in the 2016 global perception index and second after Singapore in Asia (TI, 2017). This is explicated further in one of the succeeding sections called 'Hong Kong's standing on the global context.' A total number of five different papers dealt with the subject of HK's performance against other countries in the world, most especially the countries in Asia (Kim, 2003; Lin and Yu, 2014; Gong et al., 2015; Warf, 2016). The most mentioned comparative analysis of countries' performance with regards to corruption measurement is the Corruption Perception Index (CPI) by Transparency International. Other notable measurement techniques for conducting comparative analysis are discussed later in this section.

3.7.1.1.5 International Corporation

The belief in international corporations has added enormous positive influence in HK's fight against corruption over the past decades. Bishop (1997), highlighted the significance of international corporation and liaison as a firm approach to surpass jurisdictional blockades in the fight against corrupt practices and associated criminal acts. As the former assistant operations director of ICAC, Bishop (1997) indicated that HK's ICAC was privileged to have established very profound and positive professional relations with law enforcement institutions that were outside the boundaries of HK. Such institutions included the Malaysian Anti-Corruption Agency, the Corrupt Practices Investigation Bureau of Singapore, the Macau Judiciary Police and High Commission Against Corruption, the

Federal Bureau of Investigation, the Australian Federal Police, the Royal Mounted Canadian Police, among many others. The list may go on and on, but this clearly shows that the fight against corruption may need more than just one hand, and HK, seeing the need to uproot the socio-economic menace from the SAR, had to cross the hurdle to liaising with other countries and agencies (Marquette, 2007; Quah, 2013). Even though, there was a forecast of some of the possible constraints or challenges that could have cropped up such as bureaucracy, incompatible and divergent national legislation, etc. HK was ready to pay any price to thwart and finally annihilate the root causal instigators of corruption. The team-up spirit showcased by HK has proven to be one of the active drivers of anti-corruption measures adopted by HK (Holmes, 2015).

3.7.1.1.6 Public concerns

Public trust in institutional organizations as well as governmental organizations is very vital to the effective application of anti-corruption measures and also promotes the willingness of the general populates to drive their support on issues concerning corruption when needed (Fard and Roastamy, 2007). The concerns of the general public on the issue of corruption should, therefore not be taken for granted. For instance, one negative outcome reported by Weng et al. (2015) on the issue of public trust indicated that there was a strident decline in the trust of about 2100 HK residents in the Chinese government with the notion on the prevalence of corruption. This led to a shortfall in their willingness to donate to support victims of earthquake disasters in China. Inasmuch as HK is believed to be making continual and pragmatic progress in the fight against corruption, there are occasions when their trustworthiness is questioned by the public sometimes.

However, the positive implications attached to is the demand for accountability from the ICAC to stand in a position to give fair accounts of their day to day activities. For the ICAC to win the trust of the entire HK populates, there is also the need to hold firm integrity. As recorded by De Speville (2010), sometimes, the lack of trust on the side of the public may have some very negative implications on the reliability of information that would be given by a person during investigations. However, on the other hand, once the general public develops a sense of trust, such as confidentiality of data of persons who

report corrupt cases, some barriers of effective anti-corruption measures such as fear of being noted as a reporter can be eliminated. This will add on to the smooth running of the ICAC (Fard and Roastamy, 2007; Speville 2010).

3.7.1.2 Extracts from the ICAC Reports

The ICAC was formulated at the time when corruption in HK was incredibly pervasive, coupled with legitimacy and moral crisis as a result of the incidences of corruption (Bishop, 1997; Cheung, 2008). With the adoption of a very comprehensive and pragmatic three-pronged approach, namely, prevention, enforcement and education, the ICAC has been categorized as not only one of the top anti-corruption institutions in the world but also a very successful tool against the menace of corruption and dishonest governance. The focus of information extracted from the ICAC reports was restricted to the complaint reports made over the past decade as well as the individuals cautioned and prosecuted over the past ten years.

These three sections were selected based on the following justifications: to find out whether the internal records by the ICAC have any reflection on HK's global ranking. From **Fig. 3.12**, it is revealed that the year 2000 to 2003 recorded the maximum number of documented cases over the past decade with the last three years (2013-2015) recording the least number of complaints although the decline began from 2012. Similarly, the years 1999 to 2002 in **Fig. 3.13** recorded the highest number of individuals prosecuted over the years, although the year range for the highest number of cautions is recorded from 2002 to 2004. However, the least reported number of both cautioned and prosecuted persons are also recorded in 2012 to 2015, just as in the case of the total number of complaints received by the ICAC. Although a typical relationship that can be drawn here is that the number of complaints has a direct correlation with the total number of cautioned and prosecuted persons. This hypothesis can be empirically tested in the future. The issue of concern raised in this section is that, does the reduction in the number of complaints as well as the total records of both cautioned and prosecuted persons simply reflect that there is also a decline in corrupt practices? In order words, is there a direct relationship between the number the recordings of the total number of complaints, cautions and positions and the

performance of HK in the international ranking? The discussion section explicates this notion after a thorough assessment of HK's performance in the global rankings.

3.7.1.3 Reported cases over the last two decades

The graph above depicts the number of complaints recorded by the Independent Commission Against Corruption (ICAC) of Hong Kong over the last two decades. After the construction of the Hong Kong Airport in 1998, Hong Kong, though regarded as a clean country regarding corruption incidence, yet recorded its high level of complaints from 2000 to 2003, a few years just after the construction of the airport. Afterward, there are still many reported cases that prove the incidence of corruption in Hong Kong. Also, although the chapter intends to adopt the lessons from Hong Kong to better the systems of developing countries since they are still trotting their way through corruption, yet, it is expedient that the state of corruption in Hong Kong is readdressed and strategic measures to curtail its incidence be rechecked. This chapter is as well placed in that line to fill the gap, although it would be tailored to the proneness of the stages of procurement to corruption.

Table 3.7: Statistics on corruption in Hong Kong for the past 2 decades

	Complaints, Cautions and Prosecutions Cases				Global Performances of HK		
Year	Individuals Cautioned	Individuals Prosecuted	Number of complaints	Yr 20	CPI TI	WGI	WEF
1996			3086				
1997	59	315	3057				
1998	64	382	3555				
1999	81	504	3561				
2000	94	608	4390				
2001	85	535	4476				
2002	116	604	4371				
2003	113	421	4310				
2004	132	494	3746				
2005	51	356	3685				

2006	45	341	3339	06	86	94	80
2007	49	353	3600	07	83	94	83
2008	54	357	3377	08	81	94	83
2009	54	342	3450	09	82	94	83
2010	30	393	3427	10	84	95	81
2011	54	283	3868	11	84	94	82
2012	27	245	3731	12	77	93	84
2013	28	220	2515	13	75	92	84
2014	26	223	2237	14	74	92	82.3
2015	35	213	2595	15	75	92	75
2016				16	77		74

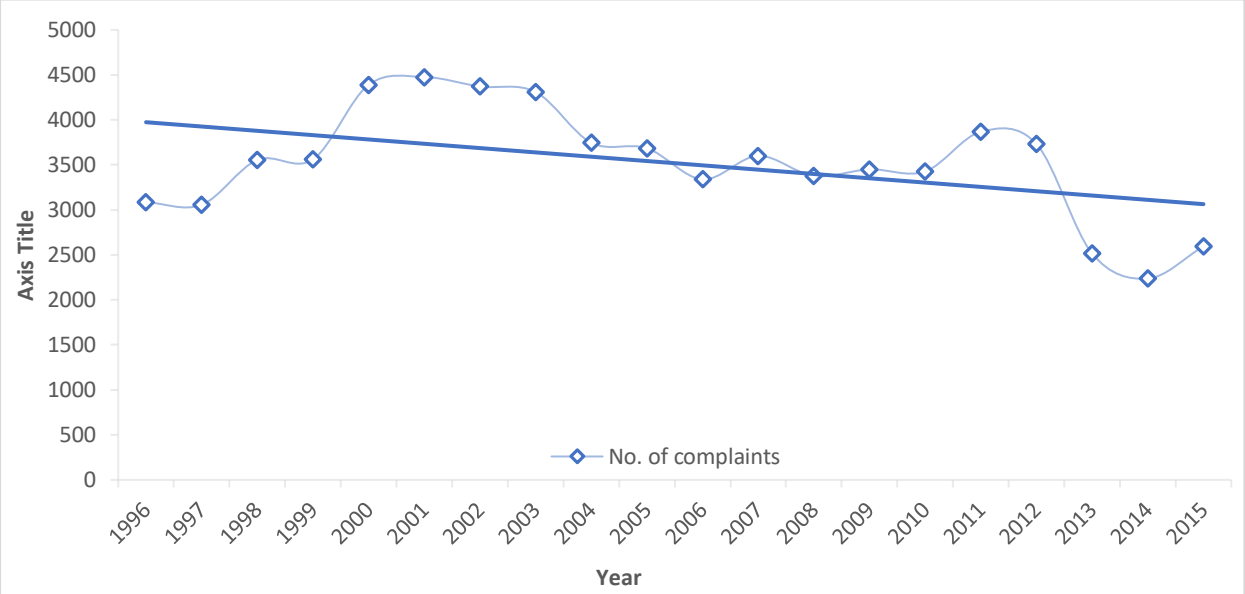


Figure 3.11: Number of complaints recorded by ICAC from 1996-2015

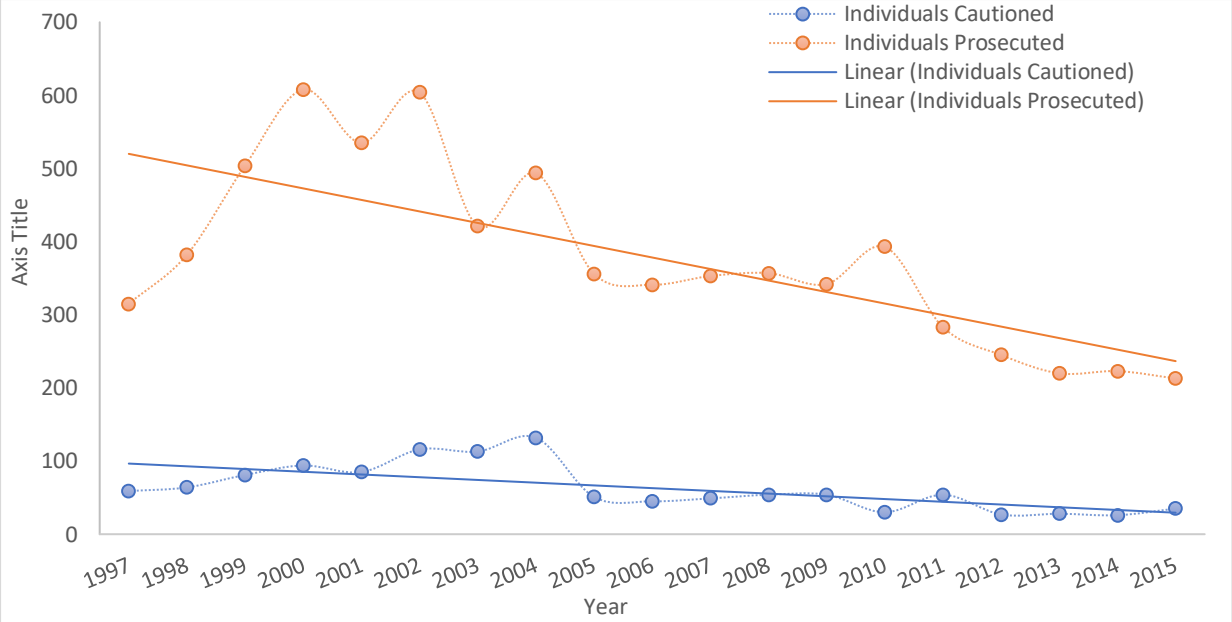
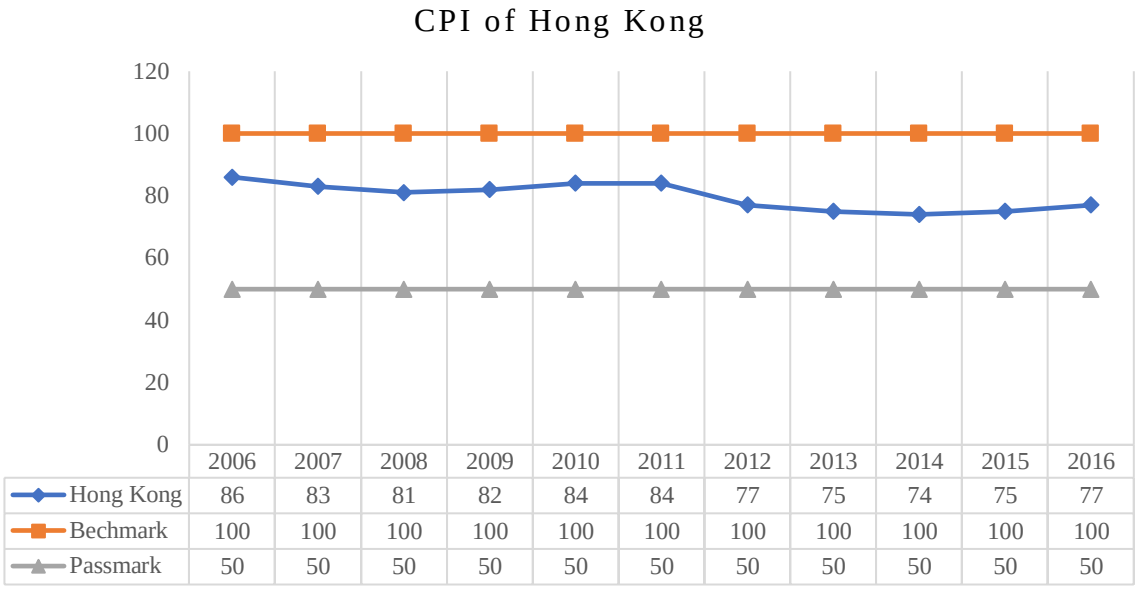


Figure 3.12: Individuals Cautioned and Individuals Prosecuted recorded by ICAC from 1997-2015

3.7.1.4 Hong Kong's Integrity and Performance in the Global Context

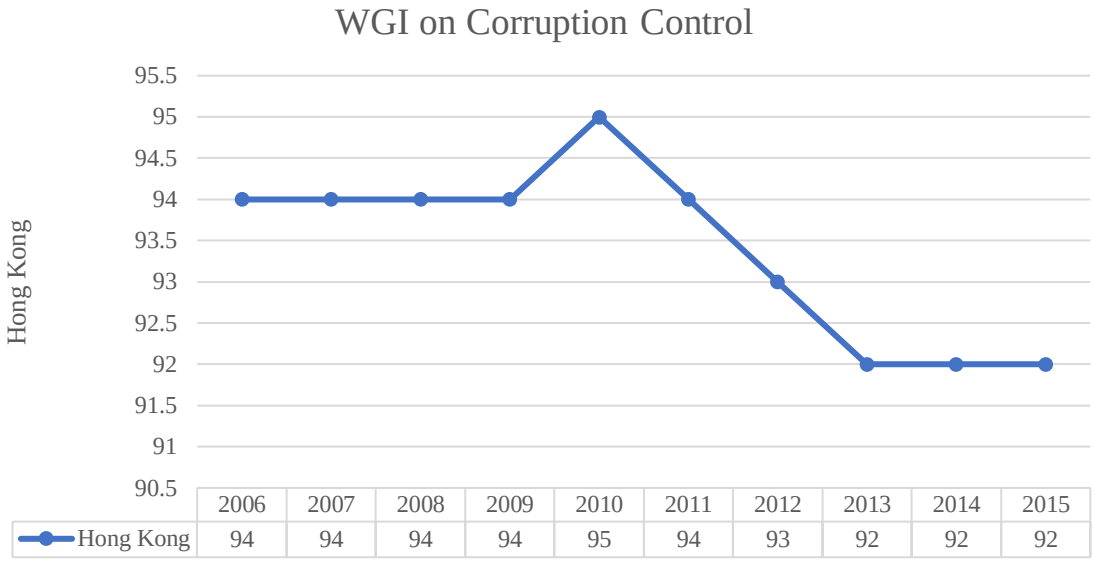
Integrity refers to the qualification of having very high moral principles that reflect in one's sense of honesty and good ethical standards. It is, therefore, a choice of holding oneself to consistent ethical or moral standards (Cambridge, 2017). This quality is essential for governments because it determines the level of trust the citizens, as well as foreign donors and investors, can put in the state. Moreover, according to WEF (2017), one of the units of measurement for a government's integrity is the level of corruption prevalent within the government or its public sector. There are several institutions with various tools to measure the perception of corruption prevalence in countries worldwide. However, to assess the performance and HK's government's integrity by an unbiased and fair judgment, this section limited the number of institutions for assessing corruption indexes to three, namely, Transparency International, the World Bank, and World Economic Forum. Transparency International is noted for the assessment and the rankings of the countries in the world in terms of corruption perception. The World Bank assesses the control of corruption of individual countries, which form a part of the six worldwide governance indicators, and lastly, the World Economic Forum investigates the integrity of the governments worldwide, which as well forms a part of the Economic Freedom Index of countries. These three assessment tools were identified to evaluate the standing of corruption on the global scene.



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Hong Kong	86	83	81	82	84	84	77	75	74	75	77
Bechmark	100	100	100	100	100	100	100	100	100	100	100
Passmark	50	50	50	50	50	50	50	50	50	50	50

Figure 3.13: Corruption Perception Index (CPI) of Hong Kong

Source: Transparency International (2017)



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Hong Kong	94	94	94	94	95	94	93	92	92	92

Figure 3.14: Worldwide Governance Indicators, (WGI) on Corruption Control

Source: World Bank (2017)

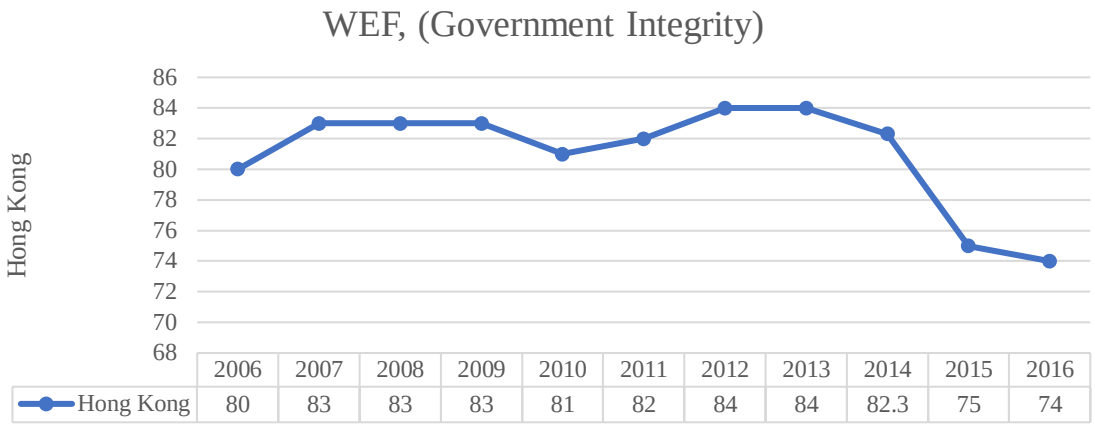


Figure 3.15: Global Competitiveness Index on Government Integrity (2017)

Source: World Economic Forum

Fig. 3.14 illustrates the data collated from Transparency International over the last decade. Transparency International evaluates the perception of corruption of countries using a 10-point scale. The range of the figures from 0 indicates an extreme prevalence of corruption within a government, to 10, which indicates either a clean state or a small indication of corrupt activities. In stipulating the marks for each country, there is a conversion of the points of the CPI raw data into a scale of 0 to 100 by multiplying the scores of the CPI by 10. Therefore, a country with a raw score of 5.5 for a particular will attain an overall score of corruption freedom score of 55. However, considering n both extremities, no country is either achieved a total point of 10 or the least point of 0. **Fig. 3.14** represents the CPI scores of corruption from 2006 to 2016. HK has been doing quite well within TI's ranking for the past decade. The reason being that the SAR has never crossed the threshold of 50, which indicates a sign of weak or poor performance. With a current score of 77, it is justified that HK was better ten years ago than it is now. From the year 2006 to 2011, HK CPI's ranged within the '80s, but there has been a reduction in the last five years. Although the performance is not bad, the issue generated here is, what led to the decline, and what pragmatic measures are being taken to resolve the declination?

Fig. 3.15 and **3.16** above illustrate the rankings of Hong Kong by the World Bank and the World Economic Forum, respectively. World Bank's assessment is conducted regarding the government's control over the incidence of corruption, whereas WEF, measures the integrity of the government. In

all cases, the maximum threshold is 100. However, one interesting finding that was observed in both data, as well as that of TI's CPI, was the decline in all the scores from the year 2012 to 2016. In other words, the performance of HK over the past decade had been magnificent until the year 2012, when they started measuring a declination in all their performance on corruption control. One effectual recommendation that can be made here is a thorough throwback investigation of the causal instigators and the risk factors that led to the decline from 2012 to 2015 to measure the standards that HK enjoyed up to the year 2011. However, despite the observed shortfall recorded from 2012, HK's performance has comparatively been outstanding over the years since the establishment of ICAC. This is because, although HK is regarded as a Special Administrative Region, it still forms a part of China, which is ranked very low in the international scene.

For instance, the TI's CPI ranks China 79 with a score of 4, which is below the pass mark and regarded as not a clean country by the definition of the CPI. This section highlights the performance of HK over the past years, and it is observed that the top anti-corruption institutions in the world today ranks HK as one of the clean cities in the world that other corrupt governments or countries can look up to as an exemplary model to learn from. This is especially applicable to corrupt developing countries looking at the history of corruption in HK.

3.7.1.5 The Way Forward for HK

The data representing HK's performance on the global scene indicated a fall in performance over the last four years, that is, commencing from somewhere around 2011 and 2012. Comparatively, HK's performance in the control of corruption has dropped during the final quarter of the entire decade as opposed to the early parts of the decade. Also, comparing **Fig. 3.12** and **3.13** which represent the total complaints cases, and the total estimates of cautioned and prosecuted cases from the ICAC report respectively, it is identified or realized that the number of complaints begun to drop from 2012, the same year that HK's performance in the global assessment also dropped to its lowest point (in that decade). Moreover, an analogy is drawn on the total estimates of individuals cautioned as well as those

prosecuted. The least of all the total estimates chronicled over the entire decade was recorded in 2012, although the total number of individuals prosecuted hit the range of 200 was in 2011.

In a logical reasoning spectrum, it may be argued out that the low records of the total estimates of both individuals cautioned and prosecuted would have indicated that the control of corruption in HK is on the rise since fewer people are being cautioned and prosecuted as compared to the previous years. However, the opposite was the case, in these years that HK recorded the least or declined numbers in the total complaints, persons cautioned and prosecuted, those were the same years that their performance on the international rankings dropped. What could be the possible indicators of this drop? Could it be possible that there was a possibility of a decline in the trust in ICAC by the HK populates that resulted in the decline in the level of complaints, or there could be other possible causal instigators? These are key issues arising from the comparisons of both the ICAC reports and current literature that need further investigation to be addressed to cause the needed improvements in corruption control in HK.

Moreover, although HK's ICAC is regarded as a success model, the possible reduction in the total number of complaints, persons cautioned, and prosecuted do not necessarily indicate a reduction in corruption. On the other hand, the opposite might even be the case, which this section has explicitly delineated. This could set as one of the shortfalls or possible unidentified challenges to the fight against corruption or the control of corruption in HK, which needs a thorough investigative study to explicitly demarcate the possible factors that led to the fall or reduction in the performance.

However, it is no doubt that HK's strategy to combat corruption remains as one of the top ideal solutions in the world today, and the ICAC also serves as an excellent exemplary for successful combat and reduction in corrupt practices. With the constant enforcement of the three-pronged approach, corruption has reduced drastically in HK now as compared to over a century ago. Countries such as Australia, Singapore, Botswana, Madagascar, and many others have benefited from this strategy adopted by HK over the years. This is proven in the number of recorded number of visitors to the ICAC every year. For

instance, the ICAC had a total number of 4210 visits from 53 different countries in the world and 11 regional and international organizations, including the World Bank (ICAC, 2015). In the case of Botswana, their testimony explicates that emerging economies can adopt this approach in the fight against corruption.

Lastly, even though there will be a need for the establishment of independent anti-corruption bodies just as in the case of HK when the need arises in many countries having no such institutions. Any country without such body but is determined to obviate corruption in the public sector may follow the footprint of HK with the motive of establishing an independent anti-corruption agency with the necessary expertise to run it effectively. It is believed that there would be possible challenges such as inadequate capital to commence the project, unnecessary bureaucratic challenges as well as other possible problems. This successful model that has been effectively adopted by Botswana and other countries can as well be adopted by other emerging economies with the notion that the latter rewards or benefits will always outweigh the initial challenges of adopting such an approach.

3.7.1.6 Section Summary

Corruption, since time memorial, has been the number one enemy and hindrance to socio-economic development in every part of the world we live in today, ranging from governments to public and private institutions. However, HK's experience has proven that the menace of corruption, in general, can be efficaciously tackled. This section sought to conduct a thorough review of the overview of corruption in the context of HK. After conducting an extensive literature search using a powerful academic search engine called Scopus, 44 valid related documents were retrieved. Another search was conducted to retrieve all the ICAC reports as well from 1974, and a total of 43 reports were retrieved, making a total of 87 documents that formed the main database for this review. This review was conducted regarding the topical coverage over the years, HK's performance in global rankings, facts from the ICAC reports, which include the number of complaints cases over the past decade as well as the total number of persons cautioned and prosecuted. The most discussed subject matters were in the area of the SAR efforts and control, Business and Rule of Law, Ethical Concerns, Emulating Hong Kong, Comparative

Analysis, International Corporation, and Public concerns. Moreover, it was interesting to find out that the reductions in the total number of complaints, cautions, and prosecutions do not necessarily reflect the improvement improvements in corruption control and, in this review, the opposite was rather the case.

The three years (2012-2015) that recorded the least number of the complaints cautions and prosecutions were the same years that HK performed very low in the international rankings. Also, as suggested, there is a need for empirical research to investigate the causal measures of the decline in performance and the possible causes of the complaints over the past stipulated years. This will help improve the HK's performance in the control of corruption. However, the success model of ICAC was highlighted, indicating the possibility of other countries, most specifically the emerging economies to adapt their strategy in the fight against corruption since this approach has yielded positive results in Botswana and other countries. Hong Kong is therefore advised to keep up with the momentum to constantly battle down the peril of corruption since other countries continue to look up to them. As an extension on the topic of corruption, this section contributes to a deepened understanding of the dynamics of corruption in the context of HK. It would be useful for not only policymakers and anti-corruption institutions but also law enforcement agencies and researchers in developing strategic measures to deal with the prevalent peril of corruption in both developed and emerging economies. It also stipulates how to strategically adapt the footsteps of Hong Kong's efforts in dealing with corrupt practices. With this, corruption will not only be thwarted in HK or Asia but also the entire world.

3.8 Chapter Summary

This chapter concluded a thorough contemporary review of the various constructs of corruption explored under the topic of corruption within the larger scope of construction engineering and management. Thus, the pressing issues within the sector and the associated activities were reviewed to determine the extant indicators contributing to the incidence and proliferation of corruption within the sector and associated activities. Particularly regarding the procurement process of infrastructure works.

As a result, constructs such as the forms of corruption, causal factors, risk indicators and the vulnerability of the procurement process to corruption were reviewed. Moreover, the measures stipulated overtime to check and extirpate the criticalities of the negative constructs were reviewed. A further search was conducted to determine the factors that impede the effectiveness of these measures. Lastly, the implications of the various constructs of corruption within the regional settings, particularly the geographical focus of this study (i.e., Ghana and Hong Kong) were reviewed at this-stage. The variable and indicators obtained from the constructs and the geographical contexts represented the foundational indicators for further empirical examination.

CHAPTER 4 – CONCEPTUAL FRAMEWORK DEVELOPMENT[8]

4.1 Introduction

Literature is not consistent with the etymology of corruption, for instance, while Hogdson and Jiang (2007) attributes the root of the word "corruption" to the Latin adjective '*corruptus,*' which means destroyed, broken or spoiled, Johnson (1996) also attributes its derivation from the Latin word '*corruptio*' which signifies a wicked behavior, putridity or moral decay. However, in all instances, one commonality that exists between the two views, moral decadence, is evident in the industry today (Henry, 2009; Sohail and Cavill, 2008; Bowen et al., 2012; Shan et al., 2015). Jain (2001) purported that corruption has many definitions across diverse contexts, but per the suitability of this context, that is the construction industry, corruption is deemed to be the abuse of entrusted power and construction project resources for personal gain (Le et al., 2014). Corruption, which may occur in varying forms as mentioned and can as well transpire in any construction activity and at any phase of the construction process, that is, from conception to completion (Tabish and Jha, 2011; Boyd and Padilla, 2009; Stansbury, 2005; FIDIC, 2016).

In the procurement of construction works, FIDIC (2016) opined that corruption might occur in many instances such as decision-making on claims, payment certificate issuance to contractors, construction supervision, in tender evaluation, etc. The stages involved in the IP process are, therefore, exposed to these corruption forms and other examples of corrupt practices due to the causal factors identified in this section. Although certain stages of the construction process are deemed to be more prone to corruption than others, no empirical studies show the stage of the construction process that records high frequency of corruption cases. However, some corrupt practices peculiar to different stages of the construction process that have been captured in literature over the years have been encapsulated together to develop **Fig. 4.1**. **Fig. 4.1**, therefore, demonstrate some corrupt practices that have been reported in

[8] This chapter is fully or partially published in the following journal article: Owusu E. K Chan A. P. C. and Darko A (2018). Owusu, E. K., Chan, A. P., & Darko, A. (2019). Thematic Overview of Corruption in Infrastructure Procurement Process. *ASCE Journal of Infrastructure Systems, 25*(2), 02519001.

studies (corruption research in construction) over the years. It illustrates the framework for corrupt practices, formulated for easy identification of the likely incidences of corrupt acts that may transpire during the project process. **Fig. 4.1** was developed from adaptations of the frameworks developed by Sohail and Cavill (2008); Zou (2006); Stansbury and Stansbury (2008); Bowen et al. (2007; 2012); Tabish and Jha (2011); Shan et al. (2016), as well as the findings identified by the publications selected for this review. Most of these studies may mention either one or multiple corrupt practices with their associated actors and the stage of the construction process where the identified acts are likely to occur. Therefore, after a thorough assessment of the identified acts, the framework was developed to highlight some possible acts of corruption in the construction process. Although the acts identified in each stage are not exhaustive, the framework was developed to inform industry practitioners, policymakers, anti-corruption institutions as well as researchers about the probable examples of corrupt activities identified in construction processes over the years and the need to avoid them.

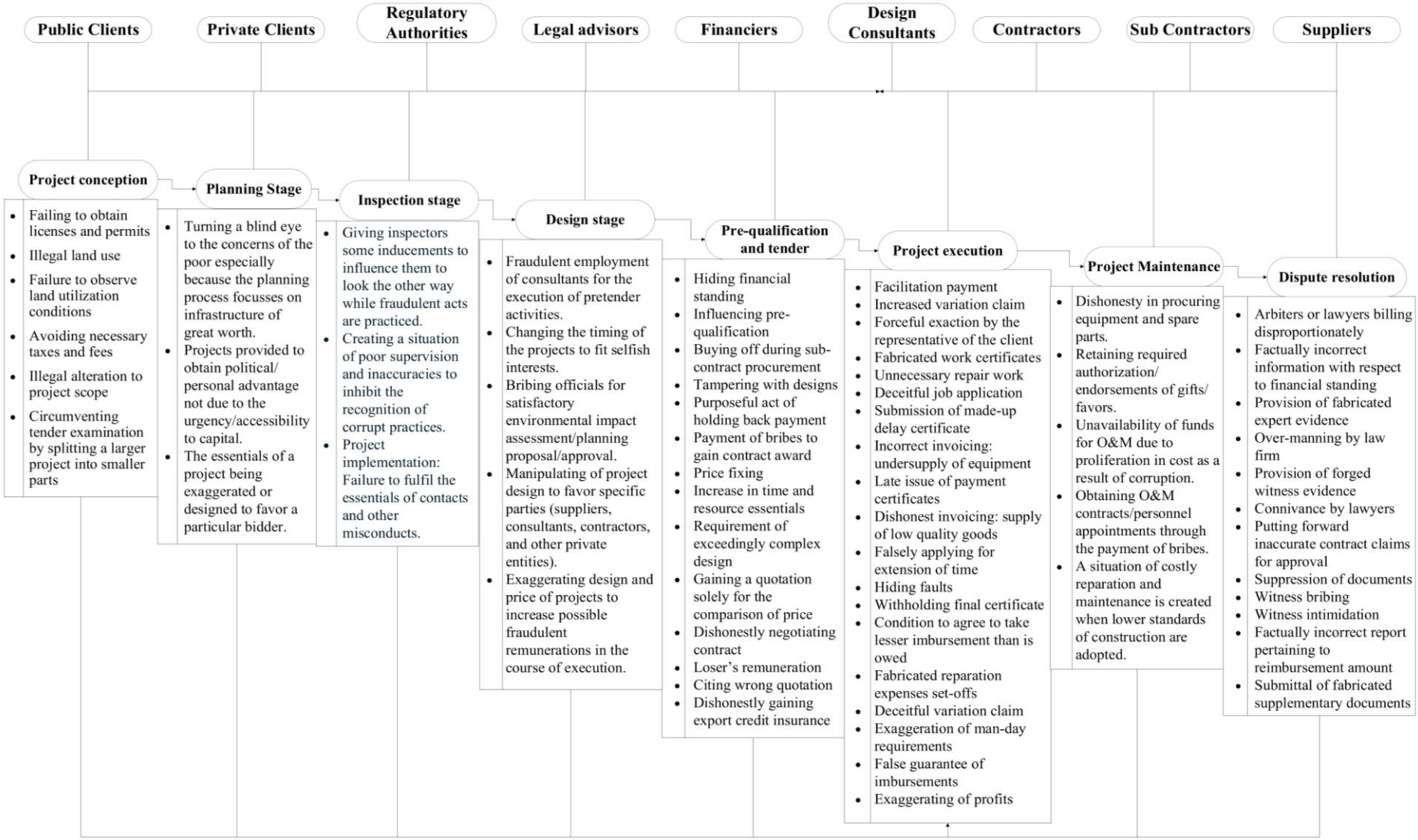


Figure 4.1: Corrupt practices framework (Adapted from various literature)

4.2 The Procurement Process

Many public and private enterprises globally regard corruption in IP as an inescapable fact of life. As pointed earlier, this is not uncommon in the developing countries as corruption adversely influences the day-to-day modus operandi of the procurement of infrastructure projects, goods, and services. From all the deductions made so far, corruption in this context can be defined as the abuse of position, regulatory, legal or political leverage to extract extra costs allocated to the procurement of infrastructural projects. In this event, the project financier or developer may never recoup the loss incurred, and the perpetrators mostly deny their involvement thereof (Wang et al., 1999; Shan et al., 2016). According to the World Bank (2003), corruption has been one of the utmost barriers to socio-economic development, which does not only result in misappropriation of resources but also, loss of lives and properties (Lewis, 2003). Corruption destabilizes development by weakening the economic foundations of institutions and distorting the rule of law (Tabish and Jha, 2011).

In public projects, some of the widely identified adverse effects of corruption include the execution of substandard construction works and the distortion of the entire procurement process. Corruption does not only reduce the life spans any infrastructure by 50% or more (Kenny, 2012) but also worsens both cost and time performance, and the benefits delivered (Locatelli et al., 2017). This is often due to the criticality, fragility, and vulnerability of the entire procurement process to corrupt behaviors. Bower (2003) also indicated that a construction project is an intricate process organized through different links and integrates the interests of many stakeholders to achieve a built facility, possibly at the best price, highest quality, and within the best specified time frame. Procurement constitutes a very vital component of realizing every construction project. According to Clough et al. (2000) and Martins (2009), procurement includes purchasing, sourcing, and every other activity connected to providing supplies, materials, equipment, workforce, knowledge, management services, and supervision to accomplish stipulated objectives of an infrastructural project. Procurement usually connects a highly fragmented supply side, typically professionals in the construction industry, which include contractors, architects, engineers, suppliers, surveyors, laborers, and builders to a less fragmented demand side

which includes clients, project representatives, owners and financiers. Bower (2003) highlighted that since every construction project goes through a procurement phase, there is a high potential for procurement as a practice to influence project management in a positive direction. Likewise, a possible flaw in procurement can create an adverse effect on project management. The susceptibility of any procurement phase to corruption exposes an entire project to the risk and awful impacts of corruption. There is, therefore, a need to critically and empirically access the vulnerabilities and other associated risks the procurement process faces regarding corruption.

Over the past two decades, there has been a growing interest in corruption research in IP, contributing immensely to the increase in the body of knowledge in this subject area. However, there is an absence of a unified view and a systematic review of research studies dedicated to IP over the years, which is essential for further studies. This chapter, therefore, aims to conduct a systematic and holistic review of corrupt practices in IP processes. Moreover, this chapter presents a conceptual framework of a dynamic model for assessing corruption in IP process and is formulated to serve as a valuable reference for industrial practitioners and researchers interested in corruption and how to deal with it in IP.

4.2.1 Understanding the Systems, Policies, and Processes in IP

Procurement is defined as an act of purchasing or obtaining goods, works, or services at the best 'value-for-money' rate (Love et al., 1998). Procurement systems, on the other hand, are best described as the organizational systems that delegate responsibilities and powers to individuals and firms and explicitly outline all the possible elements in the construction of an infrastructure or a project (Love et al., 1998; Liu and Wilkinson, 2011). According to Ogunlana (1999), the procurement systems regulate labor division among the experts or parties involved and controls the modus operandi of all the processes along with associated rules and the contractual relations. The primary considerations for any procurement system include the condition of contract, project delivery method, and the price formation method (Eriksson and Westerberg, 2011; Sutt, 2011). To ensure the success of a building project, one

of the primary factors to put right is the construction delivery method or system to be adopted (Bennett and Grice 1990; Chan 2000).

The selection of an apropos procurement system is, therefore regarded as a very vital step in the process of any construction project. Construction managers or project owners are, however, duty-bound to determine a suitable procurement system right after the objectives and goals of the project are determined. Moreover, the person responsible for the determination of the listed criteria should do so as per the specific needs of the project and the project's participants' abilities to tolerate risks (Sutt 2011). An independent advisor can be selected to help a client or a project's financier identify any potential risks or vulnerabilities associated with the procurement process. Also, in drawing up measures to check or control any possible procurement risk, there is a need for the procurement entity to develop suitable and comprehensive risk-mitigating plans that encapsulate measures to deal with any possible occurrence of corruption at any stage of the IP process (Tabish and Jha, 2011). If a client makes a wrong choice, the penalty incurred may be time and cost overruns, project's quality may be compromised and a possibility of general dissatisfaction to the client (Lædre et al. 2006).

Even though studies have shown that the wrong choice a procurement system for a project may cause a serious adverse effect on the project, another adverse situation that hinders the success of efficient delivery of a project is corruption at any stage of the procurement process. The procurement method selected for a specific project will, therefore, have a direct influence on the stipulated project objectives and also the level of integration that will exist among the project team members. Other influencing variables include the nature of the project, client's resources, the ability to make changes, and other external factors such as potential changes in interest rates, changes in legislation, and so on. The systems of procurement that are frequently mentioned and adopted include fixed-price contracting (lump sum contracting), design and construct, construction management, and on-call contracting. Others include guaranteed maximum price, full-cost reimbursable, total package options, partnering, public-private partnerships (PPP), performance-based contracting, and force account. Table 4.1 summarizes and briefly describes these procurement systems.

Table 4.1: Procurement systems at a glance

Procurement Method	Description	Selection of contractor	Construction supervision	Party in charge of Design	References
Fixed Price Contracting (FCP)	FPC is a TP system that is composed of separate or distinct phases of development of design, tendering stage, awarding of contract, and different delivery phase of a construction project.	Open tendering, selective tendering	Architect	Client/ Owner	(Mearig 2004; Touran et al. 2008).
Design and Construct (DC)	In DC, the contractor remains the party responsible for designing and constructing a project as opposed TP system where the clients appoint a consulting team to design the project and a separate contractor to build. In DC, the client is given the setting a single medium of duty to manage the entire project with only one point of contact, who is the contractor.	Negotiation	Contractor	Contractor	(Chan et al. 2002)
Construction Management (CM)	In CM system, works are carried out by different sects of trades or subcontractors who have direct contracts with the client but are managed by a design contractor who is often called the construction manager (CMr). The CMr performs the duties of a consultant to the client and advice the client on cost control, construction planning, constructability, coordination, and supervision of parties involved in CM.	Competition or Negotiations for both direct and Agency CM	Construction Manager	Client/ Owner	(Walker and Hampson 2008; Donohoe and Brooks 2007)
On-Call Contracting (OCC)	Under the OCC system, the project is divided into what is termed as task orders (TO) after the client enters into a contract with a consultant. This is usually considered as a master contract and the client issues out the trade orders to the consultant at different phases of the project.	Negotiation	Project Manager	Contractor or owner	(Walker and Hampson 2008);
Guaranteed Maximum Price (GMP)	With the GMP system, there is an agreement established between the client and the contractor stipulating that the contract sum will not exceed the capped price established. This system protects the client in a manner that, if the contractor exceeds the maximum price agreed upon as the contract price, the contractor must bear the additional or incurred cost.	Negotiation	Contractor	Contractor	(Walker and Hampson 2008; Ruparathna and Hewage 2013)
Full-Cost Reimbursable (FCR)	In FCR system, the contractor is repaid the definite amount incurred in carrying out the construction works, including any additional amount or fee. Also, the client is permitted to retain control over both the design and	No competition	Contractor or Architect	Contractor or Owner	(Ruparathna and Hewage 2013; Walker

	the construction phases. This system is usually suggested where the design specifications are unknown or keep changing.				and Hampson 2008)
Total Package Options (TPO)	With the TPO system, an external party enters into a contract agreement complete the project and later transfer it built facility or project to the client. The external contracted party is therefore responsible for to designing, constructing, operating the facility and finally transfers it after the period specified in the contract.	Open tendering Selective tendering	Contractor	Contractor	(Walker and Hampson 2008)
Partnering	Partnership as a procurement system is a very well-organized management approach that delivers a win-win outcome for every contributing party of the construction team. It does so by enabling teamwork, client or customer focus, mutual objectives, open culture, innovation, long-term commitment, and trust.	Negotiation	Contractor or Architect	Contractor or Owner	(Liu and Wilkinson 2011; Cox and Townsend 1998)
Public-Private Partnerships (PPP)	Under the PPP system, the government or public sector enters into a contractual agreement known as a partnership with the private sector to provide infrastructural services. This is usually propelled by the challenges most governments or the public sector faces such as lack of capital or poor financial standings and lack of expertise and also the lack of life cycle property management consideration.	Negotiation	Contractor or Architect	Contractor or Owner	(Oyegoke et al. 2009)
Performance-Based Contracting (PBC)	PBC is regarded as an outcome-oriented contract system rather than a route of getting a facility or a project realized. This system characterizes on the results, quality, output that may be knotted to at least part of the contractor's payment, contract renewals and extensions to the realization of precise, quantifiable performance requirements and standards.	Negotiation	Contractor	Contractor	(Ruparathna and Hewage 2013).
Force Account	The FA system is also not regarded as a procurement method but rather methods of carrying out works. This method is adopted in public construction works when the project is financed by organizations such as International Fund for Agricultural Development, International Monetary Fund, the World Bank, and others alike. Therefore, the equipment and personnel used belong to the procuring entity.	No competition	Client/ owner	Client/ owner	World Bank, 2011).

4.2.2 The Procurement Process

Different procurement systems may constitute different processes. However, the common ones linked with IP begins with the determination of what to purchase and end ends with the confirmation that the procured item or the final product received, whether goods, works or services comply with the stipulated specifications (ISO, 2008; Ruparathna and Hewage, 2013). The primary consideration of every procurement system and process constitute the method of price formation, the conditions of contract, and the delivery method to adopted (Eriksson and Westerberg, 2011). Construction managers or project owners are, therefore, pushed to decide on the type of procurement system to adopt right after determining the project's aims and objectives (Sutt, 2011). According to Lædre et al. (2006), the failure to select a suitable IP system may lead to adverse consequences of the entire IP process such as time and cost overruns and poor standards in terms of project's quality. In the course of strategizing an IP process, focus should not only be directed to the functional aspects of the process such as performance, conditions of contracts, law, client and the contract strategy but also external factors such as motivation, satisfaction, leadership, learning, political environment, sustainability and culture (Rowlinson and McDermott, 1998). The basic activities that define each stage of the IP process are presented in **Fig. 4.2.**

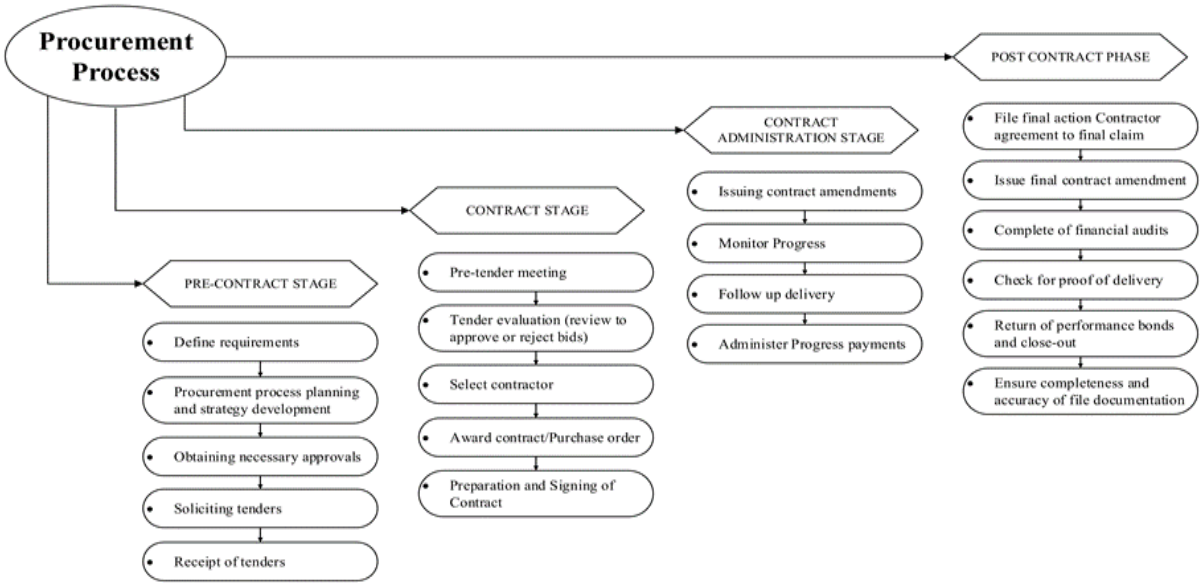


Figure 4.2: The IP Process

(Adapted from Lester, 2007; Ruparathna and Hewage, 2014)

4.2.3 Procedures and Policies

Whereas procurement systems outline the possible organizational structures for carrying out procurement, procurement procedures, and policies provide the premises for selecting a suitable contractor to support or carry out the ideal and chosen procurement system. The policies are usually shaped by client organization values (ISO, 2008). Procurement policies are thematized under three main constructs, according to Touran et al. (2008). They are value-based procurement, qualification-based, and low bid procurement. While the primary causes of procurement issues are attributed to low-bid procurement, procuring units are consequently pursuing value-based and qualification-based procurement policies. Governments usually aim to achieve the best value or value for money (Langdon and Everest, 2004; European Commission, 2011). However, due to corruption, this objective is normally difficult to achieve, although this argument cannot be generalized. Value for money in IP refers to the realization of the best and ideal amalgamation quality and full life cost to achieve the demands or needs of the customer. The different types of procurement procedures with their respective descriptions are illustrated in **Fig. 4.3.**

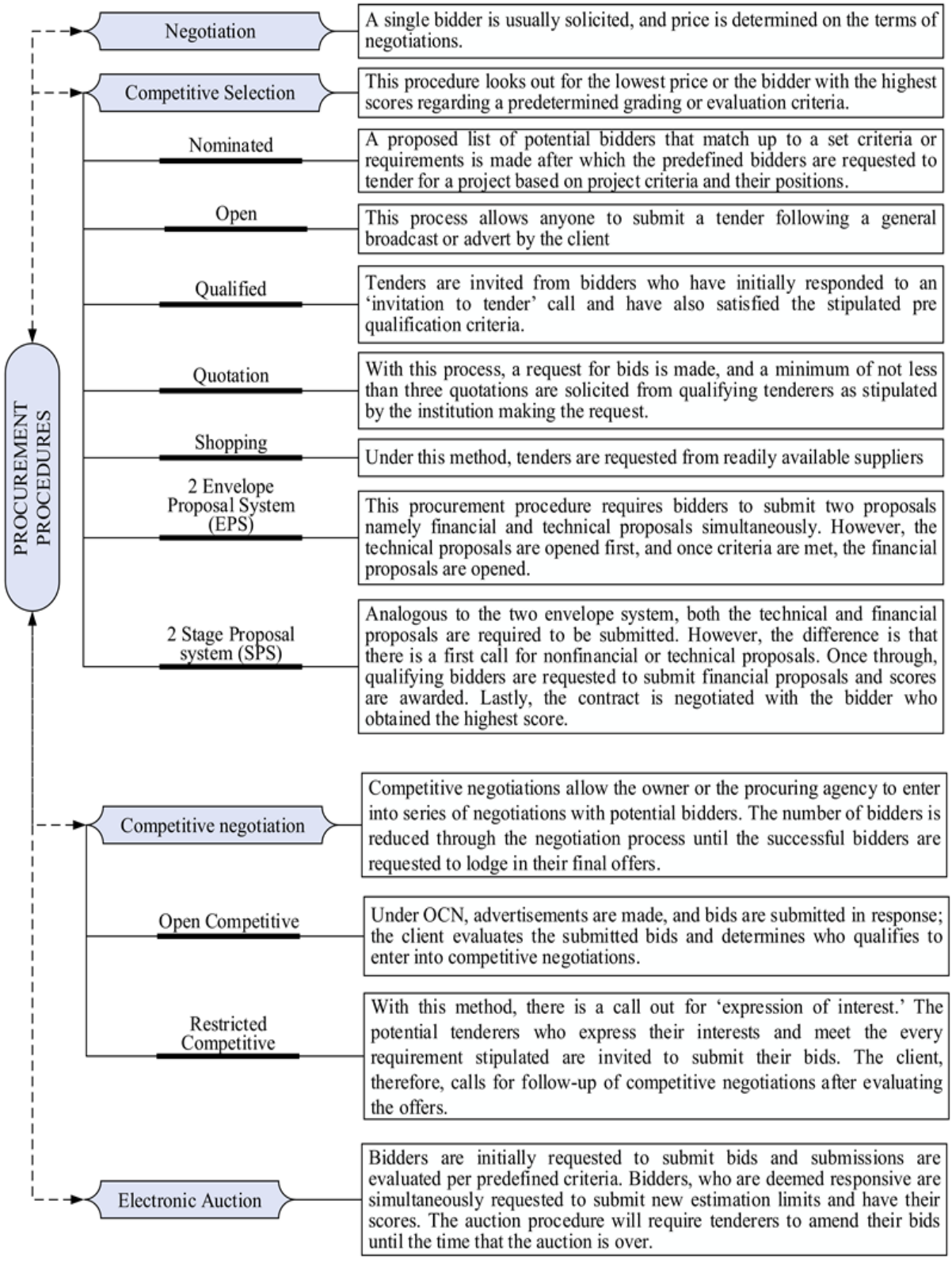


Figure 4.3: Procurement Procedures

(Adapted from ISO 2008; Ruparathna and Hewage, 2014)

Conventionally speaking, it has been identified that none of the IP stages is immune to corrupt practices (TI, 2005). The complexity of the procurement process in the pre-contract, contract, and post-contract phase makes it vulnerable to corruption practices (Heggstad et al., 2010). For instance, during pre-qualification and tendering phases, it is possible for the client representatives to either bend or amend procurement rules to favor preferred tenderers in exchange for bribes (Osei-Tutu et al., 2010). Inescapably, the process of rewarding a contract can also be highly influenced by the power relations of both economic and political organizations whose aim is to maintain the existing state of affairs (Sargiacomo et al., 2015, World Bank, 2013 Neupane et al., 2012). Other forms and examples of corrupt practices are reported in chapter three.

The impact of corruption on the procurement process has been deterring and derailing. Corruption researchers have identified some negative impacts of this menace that impair the entire procurement process leading to declining in the lifespans of projects, abandonment of projects, and the collapse of completed infrastructures, etc. (Osei-Tutu et al., 2010; Boyd and Padilla, 2009). For instance, Wang et al. (1999) identified this as one of the primary risk factors in Chinese BOT projects. Primarily in developing countries, several infrastructure projects have been abandoned due to corrupt practices in the public procurement sector (Mawenya 2008; Bowen et al. 2012). Ameh and Odusami (2009) reported on a strong correlation between corruption prevalence and poor growth, development, and performance in developing countries. Therefore, governments wishing to improve their stock of infrastructure through the PPP strategy must fight corruption in public procurement first before they can succeed in their quest to establish successful PPPs (Otairu et al., 2014). IP forms the backbone of every economy globally, and it is very critical to the survival and livelihood of humanity. Ranging from all kinds of structures (hospitals, roads, dams, etc.) to access to potable drinking water are all forms of infrastructure, and when budgets allocated to procure these needs of humanity end up being misappropriated through corruption, the net result is a socioeconomic setback. Researching corruption in IP is, therefore, crucial. As a result, over the last two decades, scholars from around the world have conducted and published many studies addressing the issue of corruption in IP. This section of the research summarizes the topical constructs of corruption-related studies explored in the context of

project procurement. It introduces how each construct, for instance, the causes of corruption impact the different activities and stages within the context of projects procurement and execution, how procurement irregularities or corruption risk indicators negatively influence the influence of corruption as well as both the positive and negative impacts posed by the various constructs of corruption on the procurement process. This section, therefore, sets the grounds for the succeeding chapters of this research.

4.2.4 Causal Mappings with Corruption

Corruption transpires as a result of certain causal factors (Chapter 3). Causes of corruption simply refer to the factors that give rise or triggers the incidence of corruption. Categorically, the factors include organizational causes, psychosocial factors, regulatory factors, statutory factors and project-specific factors (Zhang et al., 2016; Shan et al., 2016; Brown and Loosemore, 2015; Le et al., 2014; Bowen et al., 2012; Tanzi, 1998; Stansbury, 2009). Under these identified, categorical or thematic constructs lie most of the causal factors or individual variables that give rise to corruption in the process of realizing any infrastructural project.

There may be several causal instigators that enable corruption to thrive. Aidt (2003) and Locatelli et al. (2017) reported three conditions that serve as the breeding grounds for corruption to flourish. They include discretionary powers, economic rents, and weak institutions. Also, other events, such as humanitarian emergencies, which may consist of putting up infrastructural projects for deprived or underdeveloped communities or countries, creates room for corruption to thrive (Saharan, 2015). For example, in an emergency, the provision of services and amenities such as electricity, public transport, water, gas, restoration of infrastructure, and others are often provided or done in haste, which may lead to siphoning of funds (Saharan, 2015). Other causes include excessive greed, low salaries, lack of supervisory skills and the belief among supervisory staff that the payment to the contractors is insufficient for them to make a profit (Danert et al., 2003). Other causes include establishing improper or unnecessary prequalification requirements and then allowing only selected firms to bid (Deng et al.,

2003); lack of veracity by public servants entrusted with IP, weak accountability, and bad governance. Lastly, the lack of auditing procedures, political instability, low level of professionalism of the bureaucracy, lack of transparency and accountability were among other notable causes (Del Monte and Papagni, 2007; Neupane et al., 2014; Kolstad & Wiig, 2009); monopoly power over a good or service (Klitgaard, 1988).

According to Boyd and Padilla (2009), this issue of corruption is deeply rooted in the very core of public enterprises, and in sectors where employees are not satisfied with their remuneration, they tend to supplement it with proceeds of corruption. These kinds of causal factors are regarded as systemic corruption and would be difficult to wipe out without palpable and major alterations in government practice. Analogous to IP, due to the intricate process, systems, and procedures involved, corruption may be very difficult to identify unless proper auditing and mitigating measures are put in place. Therefore, to deal with the menace of corruption, it is expedient to deal with it from the causes as listed above, although taking other factors into consideration, such as the forms of corruption to be dealt with and others. This notion has underpinned the need for researching corruption purely to identify the causes behind the act.

4.2.5 Corruption Forms within the Procurement Process

The evolution of corruption over the years has resulted in many different and unique forms of corrupt practices and can be termed as the different faces or manifestations of corruption (Chan and Owusu 2017). TI (2005) broadly categorizes the CFs into two main constructs, namely petty and grand corruption. Whereas petty corruption is concerned with smaller contracts, for instance, minor infrastructural or developmental projects for local governments, grand corruption involves large contracts usually executed by the state or central governments through self-funding or help from donors (TI, 2005). Each one of these forms may have their relative causal instigators or common causes, and their nature and characteristics may also vary widely from one another, although some of the forms share some common traits.

For instance, Chan and Owusu (2017) identified some forms pertaining to the construction industry and IP in general and categorized under five main factors. The variables under these components shared either common meanings or terms that were used interchangeably. The five main categories of CF in the construction industry include bribery acts, fraudulent acts, collusive acts, extortionary acts, and discriminatory acts. Additionally, another construct developed by the authors was unclassified due to their stand-alone nature. These forms have affected the modus operandi of the construction industry in general, and it was identified that most of the forms evolved with time, and others grew more pervasive because measures were not taken to address them the time they were discovered.

The case is somewhat true with the prevalent forms of corrupt practices in IP, although the cases may be different regarding different geographic contexts. Most of the identified forms of corruption in this chapter largely center on the appointment of a contractor or suppliers and tender irregularities, and to a lesser extent on contract administration and closeout irregularities. Deng et al. (2003) has the view that the most critical and highest forms of corruption normally take place at the project performance stage, that is, after the contract is awarded. The authors emphatically pointed out that it is at this stage that the purchaser or the contractor fails to enforce suitable and stipulated standards of the contract objectives. For example, failure to enforce quality and performance standards; the ability of the contractor to sidetrack delivered goods meant for a project; resell or divert the project's resources for personal use; request for other private rewards or benefits such as trips, gifts, and many others. The authors also reported that if a bidding procedure is less open, there is a higher risk for the bid to be rigged. Sahara (2015) indicated that in the process of providing infrastructural projects for humanitarian assistance in less privileged environments, the common forms of corrupt practices exemplified include embezzlement or diversion of aid resources, misuse, and abuse of support agency assets, fraud, and bribery. Ameh and Odusami (2010) also highlighted that bribery at the contract award stage is the most evident or noticeable CF in IP. On the stance of favoritism, Kaufman (2003) indicated that it is one of the most noted forms of corruption at the evaluation stage of every bidding process and remains the

number one corrupt practice in the OECD member countries as compared to the other corrupt public governance sources.

4.2.6 Anti-Corruption Measures (ACMs) and associated Barriers in IP

After identifying the forms and causal factors of corruption in IP, the third theme that was captured in most of the papers was ACM. An ACM simply refers to any effective strategy or framework aimed at suppressing or annulling corruption (any form with associated causal factors). Previous studies conducted on ACMs classified the variables that emerged under this construct into three different categories. They are proactive or preventive measures, promotional measures, and punitive or reactive measures (Tabish and Jha, 2011; Narasimhan, 1997). In simple terms, proactive measures are set to prevent the incidence of corruption. Promotional measures are made to raise awareness and educate the entire public and the public servants on corruption. Reactive measures are also set to render punitive actions to culprit or offenders. Punitive measures are often established and enforced by legal principles, rules, and approaches for conducting effective and pragmatic investigations, disciplinary actions, and other deliberate means to daunt corrupt practices. However, the problem identified in adopting and applying the ACMs in different contexts does not lie in dispensing any of the measures but rather, how to strategically and effectively integrate and coordinate the three to treat different kinds of corruption cases in various contexts (Narasimhan, 1997). Confronting corruption in a sustained manner during the procurement of infrastructure works would require comprehensive and integrative approaches that combine preventive, public education, and punitive elements. Over the past two decades, different measures and frameworks have been developed by researchers, anti-corruption institutions, and policymakers in both public and private sectors, to thwart the incidence of corruption in infrastructure procurement. Most consulting organizations give their maximum output to develop and define anti-corruption policies. However, a number of them lack the consistency of daily execution of such stipulated policies. Others also are unsuccessful in acquiring regular and systematic responses, which may tend to enhance their transparency management systems. This has resulted in the ineffectiveness of some of the measures. Not because the measures are impotent to check corruption, but rather, there

is no one to enforce that the stipulated anti-corruption measures must be observed. This, in itself, forms a barrier to ACMs that is discussed in the next paragraph. According to Osei-Tutu et al. (2010), remedying the problem of corruption begins with awareness and recognition of its prevalence.

Raising the awareness of corruption does not only inform the audience about the practices of corruption but also the reactive measures that a culprit may receive. Also, there is some evidence from construction and other sectors that improved transparency, especially when combined with thorough oversight, can improve development outcomes through its impact on the quality of governance (Kenny, 2012). Deng et al. (2003) also indicated that a well-designed surety system reinforces transparency and restricts the opportunities for corrupt behavior, while a poorly designed surety system can foster corruption. All these and many more have been identified either empirically or theoretically by various researchers with how they can be implemented or adopted and applied to mitigate corrupt practices. On the contrary, while great efforts are constantly devoted to the development of new and innovative ACMs and frameworks to help mitigate corrupt practices in IP, there are other factors different from the causal measure, that hinder the full effectiveness of ACMs. These factors attack ACMs either by hampering the adoption of the measures of the effective applicative thereof. As an emerging thematic area that has not been deeply explored yet, one of the early works on this construct was reported by Bowen et al. (2012). The authors highlighted the barriers that affect the effective reporting of corrupt practices in the South African construction industry. These identified barriers make it difficult to achieve the full potencies of ACMs. Some of the identified barriers include the fear of being marginalized, fear of being caught reporting, social or occupational stigma and rejection, bureaucratic process of reporting corrupt cases, lack of independence, fear of victimization, inappropriate internal institutional coordination / inter-agency relations, the perception of no better end result, distrust in the system, inappropriate staffing, lack of understanding and knowledge of rights within a contractual environment, difficulty in providing concrete evidence among others were reported in the study of Bowen et al. (2012) in the South African context.

4.2.7 E-Procurement as an ACM

Electronic procurement, commonly known as E-procurement, refers to the means of acquiring or purchasing goods and services through an electronic means (Sun et al., 2012; Neupane et al., 2012). Simply put, any online transaction aimed at either selling or buying depicts e-procurement. However, in infrastructure or construction procurement, the introduction of e-procurement was implemented to facilitate the purchasing transaction of goods, services, supplies and works for either governments or project financiers and suppliers on any online platform (Vaidya et al., 2006). Even though the notion of e-procurement has been in operation for some time, it began dominating literature in the early millennium (Neupane et al., 2012). E-procurement was established on two principles, namely transparency and accountability in government procurement practices. In the quest of meeting the transparency and the accountability demands, the United Nations (2006) reported that e-procurement boots bidding automatization in the tendering process in order to enhance project monitoring, quicken and ease the procurement process, ascertain and obtain the most desired price and quality ratio, improves the competition that competitors go through and reduces the interactions and interventions of the parties involved in the bidding process (Hanna, 2011; Achterstraat, 2011; Kaliannan and Awang, 2009; Magrini, 2006; Zang and Yang, 2011; Khanapuri et al., 2011 Thai, 2001).

Moreover, since accountability, openness and transparency are the principal concerns of public procurement and also regarded as the indicators for good governance, the lack of these core values creates the flourishing grounds for civil servants or professionals to exploit their powers for personal gain (Parigi et al., 2004; Nurmandi and Kim, 2015; Neupane et al., 2014). A situation like this indicates the presence or possible incidence of corruption (Nurmandi and Kim, 2015). The atomization of the procurement system via the use of online platforms such as the internet ensures that competition is very open because every bidder can monitor the tendering process on the internet at any given time. Again, this lowers the intervention of any human to distract or corrupt the process and also reduce the degree of personal decisions to influence contract award. This, in turn, builds trust, upsurge market transparency, limit corrupt or fraudulent practice and encourage public procurement integrity (Neupane et al., 2012; Vaidya et al., 2006). This, to an extent, affirms the notion of the application of e-

procurement in public infrastructure procurement processes can serve as a very vital tool to reform government IP. However, studies on the exploration or examination of how e-procurement can serve as effectiveness against corruption in the identified systems, procedures, policies, and processes are very vital for the future of transparent, free, and fair IP by either the public or private sector (Picci, 2011).

4.2.8 Vulnerabilities to Corruption (Irregularities/risk indicators)

Corruption vulnerabilities, as the name implies, refer to systematic loopholes or 'red-flags' and are not necessarily causes of corruption. Neither do they directly trigger the incidence of corrupt practices. They can be referred to as indirect actions of IP parties that may lead to corruption in the long run. In order words, parties involved may not have the mindset to initially indulge in corruption, however, due to systematic loopholes arising from a project, the project parties may involve themselves in practices that may threaten the entire process of IP and potentially lead to corruption or to a large extent, the practice may be regarded as a form of corruption in its original status (Le et al., 2014; Tabish and Jha, 2011). For instance, the measurement items such as 'work not executed as per original specified design' and 'sufficient publicity not given to a tender' identified in the study of Le et al. (2014) as risk indicators may not necessarily be causes of forms of corruption, but they can serve as 'red flags' that may have the potency to lead to corrupt behaviors if proper investigations are not carried out to determine the rationale behind the indicators. Moreover, contrasting to the other topical areas (forms, causes, ACMs) that are more general, corruption risk indicators are more context-specific. In other words, the variables belonging to this construct vary from workplace to workplace, from institution to institution, and from country to country. One of the early works to explore this area was conducted on public procurement operations in India (Tabish and Jha, 2011). The study was conducted to analyze the irregularities in Indian's public procurement. The authors identified 61 different irregularities that could be regarded as 'red-flags' to corrupt practices in the Indian procurement works. These variables were further categorized into five main components, namely: transparency irregularities, professional standards irregularities, fairness irregularities, contract monitoring, and regulation irregularities and lastly, procedural irregularities.

However, these variables cannot be generalized since almost all of them identified in a report compiled by the Chief Technical Examiner of India. In 2014, Le et al. (2014) conducted a similar study to identify the irregularities in the Chinese construction public sector, and they identified 24 irregularities peculiar to the Chinese public construction sector. These variables are not necessarily corrupt practices but rather indicate the potential risks or the possibilities that corruption could occur. The variables can also be used to measure how prone, vulnerable, or weak an organization or a state institution is to the incidence of corruption with associated liabilities (Shan, 2015). Thus, the measurement of corruption is required to attain headway toward its reduction through greater integrity, transparency, and accountability in corruption-free performance. However, since this thematic of corruption in IP is also not deeply explored due to its context-specific nature, procurement entities and researchers in different procurement institutions or state enterprises are encouraged to conduct more research in this area to reveal the possible indicators of corrupt practices in their respective environments.

4.2.9 Conceptual Framework

After explicating briefly, the systems, policies, procures, and the common processes involved in infrastructure procurement, this section also identifies some key constructs to create a conceptual framework for examining the issues of corruption in the context of IP. Categorically, the constructs consist of the causal factors of corruption, risk indicators and forms of corruption in IP, anti-corruption measures, e-procurement, and the barriers to effective adoption and application of these measures, and lastly, the impact of corruption on the IP processes. There is the need to conceptualize how the constructs noted under corruption affect all the identified constructs in IP. With the help of the identified tools, series of empirical analyses are conducted to reveal the influences of the corruption constructs on the respective stages of IP as well as the systems of IP. **Fig. 4.4** shows the summary of the identified factors or variables encapsulated in their respective constructs.

This review revealed a very important theme, which was briefly discussed by Bowen et al. (2012) but was hardly identified or noted in other publications known as the barriers to the effective application of anti-corruption measures. Just as the three constructs above (forms, causes, and ACMs) have been deeply explored by some studies, there is the need to look into the measures that serve as hindrances to the effective application of anti-corruption measures. This may be conducted or explored contextually, for example, in a given private or public sector and during any stage of infrastructure procurement or project execution. This direction is deemed important because, in some instances, apropos measures can be put in place to check corrupt practices. However, due to some internal or external constraints, the measures set may be ineffective. However, the ineffectiveness may not be attributed to the actual measures per se but rather the constraint forces that have not been explored. It is, therefore, very keen and vital that a direction is taken to explore and address these constraint forces. Moreover, exploring the relationships between the major constructs of both corruption and infrastructure procurement is very vital for the future of procurement practice. The succeeding chapters attempt to answer the questions raised in this chapter through an empirical survey. There is a need for research to be conducted to map out and examine how the major constructs under corruption, namely cause, forms, risk indicators, ACMs, and barriers against the ACMs, influence or affect the systems, policies, procedures, and the processes involved in infrastructure procurement.

Therefore, in response to these identified gaps, all the identified constructs are empirically tested in the cases of both developing and the developed context. This is intended to show how the public IP, in general, is influenced or affected by these variables. Investigating the causal correlations will help reveal the pressing variables of the various constructs of corruption and their causal effects on the various categories of IP and how strategic measures or frameworks can be drawn to deal with this menace in IP. These also influence and inform clients, project financiers, or managers on the best system and procedure to adopt for a specific project. The findings will help develop the best strategic and comprehensive measures or framework to adapt to mitigate or help check corruption in these mentioned systems. The findings will also go a long way to influence the choice of the best system in terms and procedures to consider or adopt in terms of clean procurement. Other interesting findings may crop up

that will help the future of infrastructure procurement practice. The identified variables will, therefore, serve as the data to be tested empirically against the respective IP phases identified, as illustrated in **Fig. 4.4.**

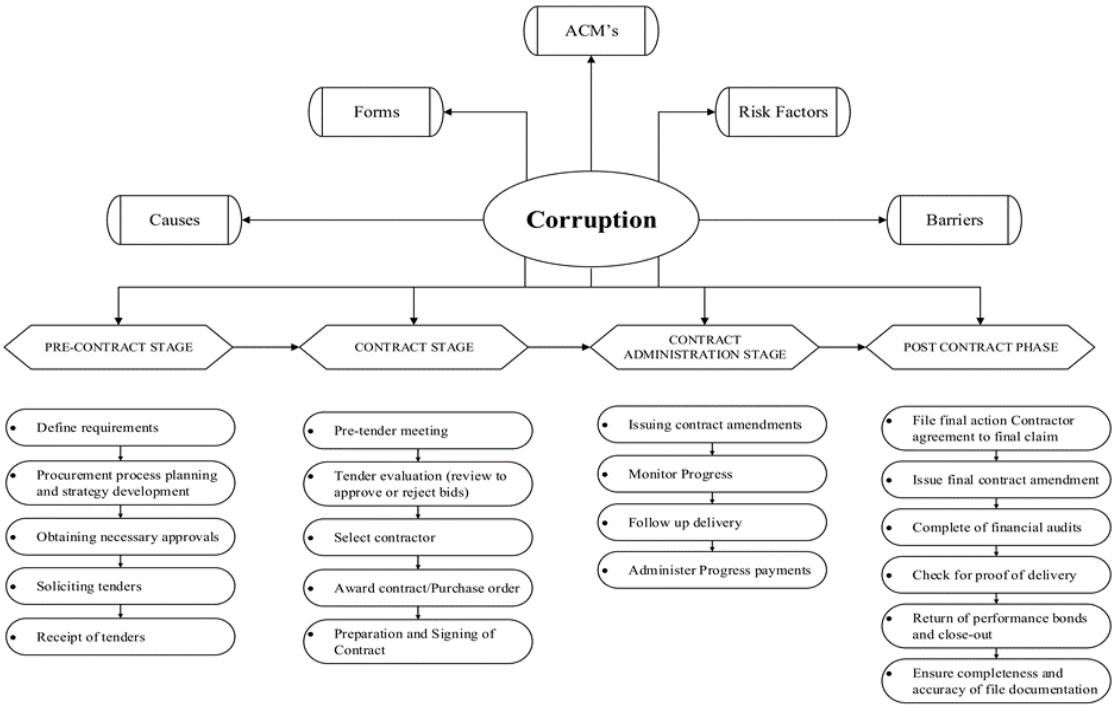


Figure 4.4: Conceptual Framework

4.2.10 Section concluding remarks

This chapter of the review sought to explore the various constructs captured under the subject matter of corruption in the context of infrastructure procurement. Following the works on the subject matter conducted in this area in these past years, there has been a significant increase in the body of knowledge on this subject matter. With the achievements of such enormous progress, a gap in the unified view of these constructs and the systematic review of the relevant literature regarding the constructs and their effects on IP practices, which are vital for future endeavors, remained unexplored.

This reason triggered the direction and the aim for conducting this review study. After a systematic and comprehensive search for publications on the topic was conducted, 48 relevant articles were retrieved and formed the foundation for further analysis. The review revealed the prevalent thematic areas of corruption explored in IP. They included forms, causal mappings, and the risk indicators, the ACMs

developed so far, and the barriers that impede the effective adoption and application of these measures in IP. The constructs identified under IP also included the systems, processes, policies, and procedures. Each of the corruption constructs is composed of individual variables that affect the IP constructs directly or indirectly. The next chapter commences the first empirical analysis of the data gathered. It explores the susceptibility patterns of the procurement process and develops the first model to estimate and predict the susceptibility indexes of the stages of the procurement process in other existing or ongoing projects.

4.3 Chapter Summary

This chapter commenced with a review of the procurement process of construction and other infrastructure-related works. The various procurement methods, policies and procedures of the procurement methods was reviewed to identify the key indicators of the various constructs mentioned. As a result, the key activities and stages of the procurement process were reviewed. Following the identification of the various methods and procedures as well as the key stages and associated activities of the procurement process, the IP process was further reviewed in terms of their vulnerabilities to the criticalities of corruption. Thus, while the various constructs of corruption were reviewed as standalone constructs in the previous chapter, this chapter extended it further by reviewing the criticalities of the constructs and the variables of corruption at the various stages of the procurement process. The amalgamation of the various indicators underlying the constructs of corruption and the procurement process formed the conceptual framework for this duty. Thus, this chapter presented the main theoretical suppositions underlying the two constructs, that are tested later in the study.

CHAPTER 5 – THE PROCUREMENT PROCESS' PRONENESS TO CORRUPTION[9]

5.1 Introduction

The early detection of the risk factors and the causal factors that propel the incidence of corrupt practices can help abate the manifestation, proliferation, and the unpleasant effects associated with corruption (Owusu et al., 2017). However, due to the difficulty in measuring corruption, it may seem impossible to establish measures to detect the likelihood of a project's vulnerability to corruption (Le et al., 2014). Given these shortcomings, this chapter attempts to develop a fuzzy evaluation model for measuring and predicting the proliferation and likelihood of corrupt practices at different stages of the procurement process of construction projects. Additionally, the present study maintains that the estimated indexes of the individual stages of the procurement process can be integrated into an overall vulnerability index to determine the susceptibility of a construction project to corrupt practices. To develop the model, this chapter was informed by the following objectives: 1) to identify the various activities that are performed at the specific stages of the procurement process; 2) to examine the susceptibility levels of the individual activities within their respective stages, and 3) to develop the measurement model for assessing the vulnerability level of construction projects using the fuzzy synthetic evaluation (FSE) technique.

Theoretically, this chapter contributes to the body of knowledge regarding the systematic approaches of measuring the various indicators of corruption in construction and other infrastructure procurement. It is, arguably, the first study to employ soft computing techniques (i.e., the FSE approach) to estimate the susceptibility patterns of the various stages of the procurement process as well as develop a standardized yet straightforward approach to facilitate similar estimations in future works. Practically, even though a rigorous technique is employed, the model is developed in such a manner that is easily

[9] This chapter is fully or partially published in the following journal article: Owusu, E. K., Chan, A. P., & Ameyaw, E. (2019). Toward a Cleaner Project Procurement: Evaluation of Construction Projects' Vulnerability to Corruption in Developing Countries. *Journal of Cleaner Production.* pp.394-407

understandable and can be adopted by practitioners (e.g., policymakers and auditors) for detecting and measuring the vulnerability of the procurement stages to corruption. The model can also form the basis for researchers to develop more comprehensive tools that extend beyond the boundaries of the procurement process for predicting, measuring and offering effective prevention measures for corrupt practices right from the definition of project's requirements through to contract close-out.

5.2 Research Design

As mentioned in the previous section, expert data were solicited to determine the indicators of the model. First, primary data regarding the vulnerability of the procurement process were solicited from experts directly involved in procurement and construction management of construction works. A questionnaire survey was conducted to solicit views from the experts concerning the constructs and the indicators that are needed to arrive at the model. Prior to the development of the questionnaire, a thorough, systematic review of the literature (e.g., Le et al. 2014; Lester, 2007; Ruparathna and Hewage, 2014; Chan and Owusu 2017) was conducted to arrive at the variables or the activities within the procurement process which are used as the indicators to develop the constructs of the model. Since the aim of the study is to measure the indicators regarding the susceptibility of the procurement process, the review conducted led to the retrieval of 21 traditional activities captured under four procurement stages (Fig. 1). The 21 activities were considered as traditional, because they can be identified in most, if not all, of the procurement systems, comprising the design and construct method, management procurement, on-call contracting, guaranteed maximum price, full cost reimbursable, and total package options among others (Ruparathna and Hewage, 2013).

The survey respondents were asked to rate the levels of vulnerability of each of the 12 activities based on a five-point grading scale (1 = very low vulnerability and 5 = very high vulnerability). Further, a section was provided in the questionnaire for the respondents to provide any known critical activity or stage of the procurement process that was not captured in the questionnaire. Questionnaires were adopted because they offer a valid and reliable source of information and are less costly (Hoxley, 2008).

Moreover, a questionnaire survey, to a large extent, warrants anonymity and the protection of respondents' data, especially on a sensitive topic of this nature (Chan et al., 2017; Ameyaw et al., 2017).

5.3 Procurement Process' Proneness Model Development

This section presents the various steps of the fuzzy synthetic technique employed to analyze the susceptibility index of the procurement process as well as develop the fuzzy model needed to facilitate the estimations of the susceptibility patterns of future projects. The following section, therefore, commences with the development of an index system for the variables prior to estimating the overall vulnerability index.

5.3.1 Developing an assessment Index System

Given the four constructs of the procurement process, the evaluation system for computing the index can be developed by establishing the construct or stages as the first or primary level index system as $V= (V_1, V_2, V_{3...} V_m)$ (Ameyaw and Chan 2015; Shao 2004). In this context, they are labeled as (V_{PCS}, V_{CTS}, $V_{CAS,}$ *and* V_{PCP}). The variables or activities within their respective procurement constructs are also defined as secondary or second-level index system as:

$V_{PCS} = \{v_{PCS1}, v_{PCS2}, v_{PCS3}, v_{PCS4}, v_{PCS5}, v_{PCS6}\}$

$V_{CTS} = \{v_{CTS1}, v_{CTS2}, v_{CTS3}, v_{CTS4}, v_{CTS5}\}$

$V_{CAS} = \{v_{CAS1}, v_{CAS2}, v_{CAS3}, v_{CAS4}\}$, *and*

$V_{PCP} = \{v_{PCP1}, v_{PCP2}, v_{PCP3}, v_{PCP4}, v_{PCP5}, v_{PCP6}\}$

The index systems are considered as the input variables for the fuzzy synthetic analysis (Ameyaw et al. 2017). The respondents were therefore required to rank the individual activities using the 5-point Likert grading system as *V= (1,2,3,4,5)* where *1= very low (VL), to 5= extremely high (EH).* Adopting the five-point grading scale in this section of the study is consistent with past studies (Shan et al. 2015; Zhao et al. 2015; Osei-Kyei and Chan 2017). The Likert scale representing the linguistic terms, which

facilitates the judgment of the experts involved in the study, and the determination of the membership functions are presented in **Table 5.1.**

Table 5.1: Input Variables' Linguistic Terms

Scale	Term	Degree of capability	Constant
1	Very low	0 – 0.25	0.125
2	Low	0 – 0.50	0.250
3	Neutral	0.25 – 0.75	0.500
4	High	0.50 – 1.00	0.750
5	Extremely high	0.75 – 1.00	0.875

Adapted from Ameyaw et al. (2017)

5.3.2 Estimations of Input Variables' Weightings.

The individual weightings of the variables or activities within the four stages of the procurement process were determined using the normalization technique. The formula for determining the normalized values or the specific weighting is given as (Lo, 1999):

$$w_i = \frac{M_i}{\sum_{i=1}^{5} M_i}, 0 < w_i < 1, and\ \sum_{i=1}^{5} w_i = 1 \qquad \text{(eqn. 5.1)}$$

Where w_i represents the weighting of the activities within the procurement stages or constructs *i*; M_i, represents the mean index or value of the specific activity or associated stage *i* generated from the survey analysis. The function set of the weights is thus given by:

$$Wi = \{w_1, w_2, w_3, \ldots v_m\}$$

(eqn. 6.2)

Therefore, using the 'check for proof of delivery,' (PCP_4), which is the fourth activity in the post-contract phase and equation (1), the weighting is calculated as follows:

$$W_{PCP_4} = \frac{3.76}{3.48+3.51+3.48+3.76+3.45+3.39} = \frac{3.76}{21.07} = 0.178$$

Using the same formula, the remaining weightings of the individual activities within their respective constructs are evaluated. The summation of the weightings of a group of activities within the same

construct must be equal to the value of one. A typical example using the PCP construct is presented below:

$$\sum_{k=1}^{6} W_{PCP} = 0.165 + 0.167 + 0.165 + 0.178 + 0.164 + 0.161 = 1.00$$

Table 5.2: MF for Stages and respective activities of the Procurement Process

	Procurement Stages	Procurement Activities	Code	Mean	N-Value	Weighting	Total mean of stages	Weighting of stages
1	Pre-Contract stage	Define requirements, v_{pcs1}	PCS1	2.63	0.00	0.133		
2		Procurement process planning and strategy development, v_{PCS2}	PCS2	3.05	0.27	0.155		
3		Pre-tender survey, v_{PCS3}	PCS3	3.15	0.33	0.160		
4		Obtaining necessary approvals, v_{pcs4}	PCS4	3.52	0.56	0.178		
5		Soliciting tenders, v_{pcs5}	PCS5	4.02	0.88	0.204		
6		Receipt of tenders, v_{pcs6}	PCS6	3.35	0.46	0.170	19.72	0.271
7	Contract Stage	Pre-tender meeting (Establishing Evaluation Criteria, Evaluation Plan, Evaluation Criteria), v_{cts1}	CTS1	3.40	0.49	0.182		
8		Tender evaluation (review to approve or reject bids), v_{cts2}	CTS2	4.00	0.87	0.214		
9		Select contractor, v_{cts3}	CTS3	4.21	1.00	0.225		
10		Award contract/Purchase order, v_{cts4}	CTS4	3.74	0.70	0.200		
11		Preparation and Signing of Contract, v_{cts5}	CTS5	3.35	0.46	0.179	18.70	0.257
12	Contract administration stage	Issuing contract amendments, v_{cas1}	CAS1	3.13	0.32	0.238		
13		Monitor Progress, v_{cas2}	CAS2	3.39	0.48	0.257		
14		Follow up delivery, v_{cas3}	CAS3	2.97	0.22	0.226		
15		Administer Progress payments, v_{cas4}	CAS4	3.68	0.66	0.279	13.17	0.181
16	Post contract phase	File final action Contractor agreement to final claim, v_{pcp1}	PCP1	3.48	0.54	0.165		
17		Issue final contract amendment, v_{pcp2}	PCP2	3.51	0.56	0.167		
18		Complete of financial audits, v_{pcp3}	PCP3	3.48	0.54	0.165		
19		Check for proof of delivery, v_{pcp4}	PCP4	3.76	0.72	0.178		
20		Return of performance bonds and close-out, v_{pcp5}	PCP5	3.45	0.52	0.164		
21		Ensure completeness and accuracy of file documentation, v_{pcp6}	PCP6	3.39	0.48	0.161	21.07	0.290
Total mean and weighting values							***72.66***	***1.000***

5.3.3 Determining the Membership Functions of the Input Variables for the Activities

Membership functions (MFs) in fuzzy set theory represent the extent or degree (within the range of 0 and 1) of an element's membership in a fuzzy set (Xu et al. 2010). Thus, regarding the MFs of the input variables, the FSE technique employs the application of membership degrees in a given set instead of a strict true or false membership (Tah and Carr, 2000). Rather than using absolute terms or values such as 0 and 1 to represent an elements association to a fuzzy set, the FSE tool expresses the element's belongingness or membership to a fuzzy set in terms of varying degree of relation.

The degree or extent of membership can, therefore, consider any value within a closed range of 0 and 1; the obtained value characterizes the degree or measure to which the element belongs to a fuzzy set (Ameyaw et al., 2015; Tar and Carr, 2000; Kasirolvalad et al., 2006). They are derived from the respondents' assessments of the 21 procurement activities using the Likert scale (as discussed). According to Ameyaw and Chan (2016), it is appropriate to designate the various levels where the membership functions are derived. Therefore, as established earlier, the linguistic terms for examining the input variables (i.e., the procurement activities) against the vulnerabilities constructs were determined using the 5-point grading system as $l = (1,2,3,4,5)$, where l_1 = very low, l_2 = low, l_3 = moderate, l_4 = high, l_5 = very high. The membership function of a given vulnerability construct was derived using the formula below:

$$MF_{v_{in}} = \frac{x_1 v_{in}}{l_1} + \frac{x_2 v_{in}}{l_2} + \frac{x_3 v_{in}}{l_3} + \frac{x_4 v_{in}}{l_4} + \frac{x_5 v_{in}}{l_5} = \frac{x_1 v_{in}}{very\ low} + \frac{x_2 v_{in}}{low} + \ldots + \frac{x_3 v_{in}}{very\ high} \qquad \text{(eqn. 5.3)}$$

Where $MF_{v_{in}}$ represents the membership function (MF) of specific activity of the procurement process v_{in}; $x_{y_{v_{in}}}$ *(y=1,2,3,4,5)* indicates the percentage of a given score *y* for an activity of a given construct as assigned by the experts (i.e., v_{in}); and $x_{y_{v_{in}}}/l_1$ denotes the relation between $x_{y_{v_{in}}}$ and its respective grade alternative. Therefore, referring to equation 3, the membership function of a specific construct can be written as:

$$MF_{v_{in}} = (x_{1_{v_{in}}},\ x_{2_{v_{in}}},\ x_{3_{v_{in}}},\ x_{4_{v_{in}}},\ x_{5_{v_{in}}}). \quad \text{(eqn. 5.4)}$$

Therefore, using the contractor selection stage (CTS3) as an example owing to the ratings by the experts (i.e., 0.00%, 1.60%, 12.90%, 48.40%, 37.10%), the membership function is evaluated as follows:

$$MF_{cts_3} = \frac{0.00}{Not\ Vulnerable} + \frac{0.02}{Less\ Vulnerale} + \frac{0.13}{Neutral} + \frac{0.48}{Vulnerable} + \frac{0.37}{Extremely\ Vulnerable}$$

The MF is, therefore, presented as (0.00, 0.02, 0.13, 0.48, 0.37). The individual members within the function range between 0 and 1, and the summation of the members must be equal to 1:

$$\sum_{k=1}^{5} x_{k_{v_{in}}} = 1 \quad \text{(eqn. 5.5)}$$

This was repeated for all the procurement activities within their respective constructs to determine their respective membership functions. The MF of all the individual activities of the procurement process were classified under level three, as presented in Table 5.3.

5.3.4 Determination of the Membership Functions for the Constructs/Stages (Level 2)

The next step after the determination of the membership functions at level three was an evaluation of the membership function at level two. That is membership function for the main procurement stages or constructs. The derivation of the membership function is derived by the formula below:

$$D = W_i \bullet R_i \quad \text{(eqn. 5.6)}$$

Where W_i represents the individual weightings of all the activities within their respective constructs or stages and R_i represents the fuzzy evaluation matrix. Following a similar approach used previously in eqn. (1), the weightings were estimated using the formula below:

$$MF_{v_{in}} = \frac{M_i}{\sum_{i=1}^{5} M_i}, 0 < w_i < 1, and\ \sum_{i=1}^{5} w_i = 1 \quad \text{(eqn. 5.7)}$$

Using CTS as an example, the weightings for the constructs were estimated as follows:

$$W_{CTS} = \frac{18.70}{19.72+18.70+13.17+21.07} = \frac{18.70}{72.66} = 0.257$$

The remaining three constructs (i.e., the PCS, CAS, and PCP) were computed in a similar as described above. In calculating for the individual weightings of the constructs, the mean scores of each stage or construct were normalized to ascertain their respective weightings where the summations of all the weightings equate to 1. For instance, the calculation for the four stages or constructs were evaluated as follows:

$$W_{PCS} = \frac{19.72}{19.72+18.70+13.17+21.07} = \frac{19.72}{72.66} = 0.271$$

$$W_{CAS} = \frac{13.17}{19.72+18.70+13.17+21.07} = \frac{13.17}{72.66} = 0.181$$

$$W_{PCP} = \frac{21.07}{19.72+18.70+13.17+21.07} = \frac{21.07}{72.66} = 0.290$$

$$\sum_{i=1}^{4} w_i = 0.271 + 0.257 + 0.181 + 0.290 = 1$$

Therefore, the weightings can be presented as follows:

$w_i = (w_1, w_2, w_3, \ldots w_i)$ = (0.271, 0.257, 0.181, 0 .290)

5.3.5 Establishment of the Multi-level and Multi-criteria FSE Model

Given that the evaluation of the susceptibility levels of the procurement process is a multi-criteria (that is, from activity to activity and stage to stage) and a multi-level (that is, from the activity level to the construct or stage level), the evaluation involves three primary stages. The first stage deals with the establishment of the MFs and the estimated weighted functions (w_i) of the individual activities (for example, PCS_1, PCS_2, CTS_4, CTS_3, CAS_1). This is known as the lower level and is based on the

assessments from the experts' survey. The second stage also deals with the establishment of the membership and weighted functions of the individual constructs or stages (PCS, CTS, CAS, and PCP). The evaluation of the respective impacts of the stages is, therefore calculated at this level. The third and final stage estimates the overall vulnerability index of the procurement process, which is presented by a single index or value. Therefore, with the establishment of the MFs and the estimated w_i of the individual activities (3rd level) which are obtained from the experts' responses, the estimations of the constructs' indexes (2nd level) and the overall vulnerability index (1st level) are discussed. With reference to eqn. (6), to determine the vulnerability levels of the respective stages of the procurement process, D_i, which represents a fuzzy matrix is first established for each of the procurement stages after the derivation of the membership functions of the activities within the stages. Therefore, following eqn. 4 [$MF_{a_{in}} = (x_{1_{a_{in}}} + x_{2_{a_{in}}} + x_{3_{a_{in}}} + x_{4_{a_{in}}} + x_{5_{a_{in}}})$] the membership functions for all the activities within their respective stages can be demonstrated in a fuzzy matrix presented below:

$$R_i = \begin{vmatrix} MF_{v_{i1}} \\ MF_{v_{i2}} \\ MF_{v_{i3}} \\ \cdots \\ MF_{v_{in}} \end{vmatrix} = \begin{vmatrix} x_{1_{v_{i1}}} & x_{2_{v_{i1}}} & x_{3_{v_{i1}}} & x_{4_{v_{i1}}} & x_{5_{v_{i1}}} \\ x_{1_{v_{i2}}} & x_{2_{v_{i2}}} & x_{3_{v_{i2}}} & x_{4_{v_{i2}}} & x_{5_{v_{i2}}} \\ x_{1_{v_{i3}}} & x_{2_{v_{i3}}} & x_{3_{v_{i3}}} & x_{4_{v_{i3}}} & x_{5_{v_{i3}}} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ x_{1_{v_{in}}} & x_{2_{v_{in}}} & x_{3_{v_{in}}} & x_{4_{v_{in}}} & x_{4_{v_{in}}} \end{vmatrix} \quad \text{(eqn. 5.8)}$$

Where the elements are presented by $x_{1_{v_{i1}}}$. Using the contract stage (CTS) as an example, the elements in the fuzzy matrix can be presented through Eqn. 8 as in:

$$R_{cts} = \begin{vmatrix} MF_{v_{21}} \\ MF_{v_{22}} \\ MF_{v_{23}} \\ MF_{v_{23}} \\ MF_{v_{25}} \end{vmatrix} = \begin{vmatrix} 0.15 & 0.13 & 0.16 & 0.31 & 0.26 \\ 0.02 & 0.03 & 0.18 & 0.48 & 0.29 \\ 0.00 & 0.02 & 0.13 & 0.48 & 0.37 \\ 0.10 & 0.06 & 0.08 & 0.52 & 0.24 \\ 0.08 & 0.11 & 0.32 & 0.34 & 0.15 \end{vmatrix}$$

It must be emphasized that the FSE technique comprises three levels of the membership functions (i.e., from the third level to the first level). The computations at this section are used to arrive at level 2. The derivation of the fuzzy matrix D_i is arrived with the application of the function set of the individual weightings $w_i = (w_1, w_2, w_3, \ldots w_i)$ of the activities within their respective stages or construct *i* as presented below:

$$D_i = W_i \bullet R_i = (d_{in}, d_{in}, d_{in}, \dots d_{in}) = (w_1, w_2, w_3, \dots w_i) \bullet \begin{vmatrix} x_{1_{v_{i1}}} & x_{2_{v_{i1}}} & x_{3_{v_{i1}}} & x_{4_{v_{i1}}} & x_{5_{v_{i1}}} \\ x_{1_{v_{i2}}} & x_{2_{v_{i2}}} & x_{3_{v_{i2}}} & x_{4_{v_{i2}}} & x_{5_{v_{i2}}} \\ x_{1_{v_{i3}}} & x_{2_{v_{i3}}} & x_{3_{v_{i3}}} & x_{4_{v_{i3}}} & x_{5_{v_{i3}}} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ x_{1_{v_{in}}} & x_{2_{v_{in}}} & x_{3_{v_{in}}} & x_{4_{v_{in}}} & x_{4_{v_{in}}} \end{vmatrix}$$

$$= (d_{i1}, d_{i2}, d_{i3}, \dots d_{in}) \qquad \text{(eqn. 5.9)}$$

Where d_{in}represents the grade alternative membership degree, v_{in} with regard to a specific stage of the procurement process; and ● connotes the fuzzy composite operation (Ameyaw and Chan 2016; Lo et al. 1999). Taking into consideration the individual weightings of the activities within cts (i.e., construct CTS), the matrix R_{cts} is normalized using equation 9 above.

$$D_{cts} = W_{cts} \bullet R_{cts} = (w_{cts1}, w_{cts2}, w_{cts3}, w_{cts4}, w_{cts5}) \times \begin{vmatrix} MF_{a_{21}} \\ MF_{a_{22}} \\ MF_{a_{23}} \\ MF_{a_{23}} \\ MF_{a_{25}} \end{vmatrix}$$

$$Therefore, D_{a_{cts}} = (0.182, 0.214, 0.225, 0.200, 0.179) \times \begin{vmatrix} 0.15 & 0.13 & 0.16 & 0.31 & 0.26 \\ 0.02 & 0.03 & 0.18 & 0.48 & 0.29 \\ 0.00 & 0.02 & 0.13 & 0.48 & 0.37 \\ 0.10 & 0.06 & 0.08 & 0.52 & 0.24 \\ 0.08 & 0.11 & 0.32 & 0.34 & 0.15 \end{vmatrix}$$

$$= (0.06, 0.07, 0.17, 0.43, 0.27)$$

The same approach was used to derive the membership function for all the other respective constructs or stages at level two. Table 5.3, therefore, presents the derivations of the membership functions at both level two and three.

Table 5.3: MF for Stages of the Procurement Process

Procurement Process	Code	Activities' Weightings	MF for Level 3	MF for Level 2	Constructs' Weightings	MF for Level 1
Pre-Contract stage	PCS1	0.133	0.29, 0.16, 0.23, 0.27, 0.05	0.13, 0.14, 0.18, 0.37, 0.19	0.13	0.09, 0.12, 0.19, 0.41, 0.20
	PCS2	0.155	0.13, 0.24, 0.19, 0.32, 0.11			
	PCS3	0.160	0.15, 0.18, 0.23, 0.29, 0.16			
	PCS4	0.178	0.11, 0.13, 0.11, 0.42, 0.23			
	PCS5	0.204	0.03, 0.05, 0.11, 0.48, 0.32			
	PCS6	0.170	0.13, 0.10, 0.24, 0.35, 0.18			
Contract Stage	CTS1	0.182	0.15, 0.13, 0.16, 0.31, 0.26	0.06, 0.07, 0.17, 0.43, 0.27	0.06	
	CTS2	0.214	0.02, 0.03, 0.18, 0.48, 0.29			
	CTS3	0.225	0.00, 0.02, 0.13, 0.48, 0.37			
	CTS4	0.200	0.10, 0.06, 0.08, 0.52, 0.24			
	CTS5	0.179	0.08, 0.11, 0.32, 0.34, 0.15			
Contract administration stage	CAS1	0.238	0.13, 0.19, 0.16, 0.42, 0.08	0.11, 0.16, 0.19, 0.41, 0.14	0.11	
	CAS2	0.257	0.10, 0.15, 0.19, 0.40, 0.16			
	CAS3	0.226	0.15, 0.21, 0.24, 0.34, 0.06			
	CAS4	0.279	0.06, 0.10, 0.16, 0.45, 0.23			
Post contract phase	PCP1	0.165	0.08, 0.13, 0.19, 0.42, 0.18	0.07, 0.12, 0.20, 0.43, 0.18	0.07	
	PCP2	0.167	0.05, 0.18, 0.18, 0.39, 0.19			
	PCP3	0.165	0.08, 0.08, 0.24, 0.47, 0.13			
	PCP4	0.178	0.05, 0.08, 0.18, 0.45, 0.24			
	PCP5	0.164	0.10, 0.08, 0.24, 0.44, 0.15			
	PCP6	0.161	0.08, 0.18, 0.18, 0.40, 0.16			

Note: ***MF*** connotes membership function

After determining each of the constructs' fuzzy matrix, the vulnerability level of each of the procurement stage can be estimated using the formula below (eqn. 10).

$$VL_i = \sum_{k=1}^{5} \overline{D} \times L^t = (D'_1, D'_2, D'_3, D'_4, D'_5) \times (1,2,3,4,5) \quad \text{(eqn. 5.10)}$$

$1 \leq VL_i \leq 5$

Since an analogous formula is employed to estimate the overall vulnerability index for the entire procurement process, the formula is better explained at the overall estimation section. However, using the formula above, the individual index for each stage (i.e., the vulnerability level for the individual procurement stages) is computed as follows:

$VL_{pcs} = [(0.13 \times 1) + (0.14 \times 2) + (0.18 \times 3) + (0.37 \times 4) + (0.19 \times 5)] = 3.34$, for the precontract phase;

$VL_{cts} = [(0.06 \times 1) + (0.07 \times 2) + (0.17 \times 3) + (0.43 \times 4) + (0.27 \times 5)] = 3.77$ for the contract phase;

$VL_{cas} = [(0.11 \times 1) + (0.16 \times 2) + (0.19 \times 3) + (0.41 \times 4) + (0.14 \times 5)] = 3.30$, for the contract administration stage; and,

$VL_{pcp} = [(0.07 \times 1) + (0.12 \times 2) + (0.20 \times 3) + (0.43 \times 4) + (0.18 \times 5)] = 3.51$ for the post-contract phase.

5.3.6 Estimating the overall vulnerability Index

The weighted mean method was adopted for this study. It reserves the vulnerability effects of all the procurement activities as well as constructs, an upper threshold of 1 is needed in the event of the normalization of both the activities and the constructs, and also the disparities between their respective weightings are nominal (Hsiao, 1998; Lo et al. 2016; Ameyaw and Chan 2016). This selection criterion

is as well adopted widely in the domain of fuzzy multi-criteria decision making (Ameyaw et al. 2016; Yeung et al. 2010). According to Hsaio (1998), the weighted mean {M(●, □)} approach is defined as:

$$d_{in} = min\left\{1,\ \sum_{i=1}^{m} w_{in} x_{k_{v_{in}}}\right\}, n = 1,2,\ldots\ldots, f \qquad \text{(eqn. 5.11)}$$

The notation of 1 as the upper threshold for the normalized weightings is done using the symbol "□" and the normalization of the weighted functions causes the operator '□' to regress when real numbers are added such that:

$$d_{in} = \sum_{i=1}^{m} w_{in} x_{k_{v_{in}}}, n = 1,2,\ldots\ldots, f$$

That is, the operation relapses to {M (●, □)}, and this model is termed as the weighted mean score (Hsiao 1998). The computed matrix, therefore, forms the foundational fuzzy matrix to calculate the overall vulnerability index for the procurement of infrastructure projects. Therefore, using the formula below:

$$\bar{R} = \begin{vmatrix} D_1 \\ D_2 \\ D_3 \\ D_4 \end{vmatrix} = \begin{vmatrix} d_{11} & d_{12} & d_{13} & d_{14} & d_{15} \\ d_{21} & d_{22} & d_{23} & d_{24} & d_{25} \\ d_{31} & d_{32} & d_{33} & d_{34} & d_{35} \\ d_{41} & d_{42} & d_{43} & d_{44} & d_{45} \end{vmatrix} \qquad \text{(eqn. 5.12)}$$

Where $\bar{R}$ represents the fuzzy matrix for estimating the overall vulnerability index, D_i $(i = v_1, v_2, v_3, v_4)$ characterizes the obtained evaluated matrix. A typical illustration is presented below using the final generated fuzzy evaluation matrix of the procurement constructs at level 2, which will then be used to determine the overall vulnerability index of the procurement process. This is demonstrated below:

$$\bar{R} = \begin{vmatrix} D_{psc} \\ D_{cts} \\ D_{cas} \\ D_{pcp} \end{vmatrix} = \begin{vmatrix} 0.13 & 0.14 & 0.18 & 0.37 & 0.19 \\ 0.06 & 0.07 & 0.17 & 0.43 & 0.27 \\ 0.11 & 0.16 & 0.19 & 0.41 & 0.14 \\ 0.07 & 0.12 & 0.20 & 0.43 & 0.18 \end{vmatrix}$$

Using equation 12 above, the fuzzy matrix, $\bar{R}$, is afterward normalized through the determined weighting function set of the individual constructs of the procurement process $(w_1, w_2, w_3, w_4)$to estimate the fuzzy evaluation matrix of the final stage, as explicated in the previous section:

$$\bar{D}_i = \bar{W}_i \bullet \bar{R}_i = (w_1, w_2, w_3, w_4)x \begin{vmatrix} d_{11} & d_{12} & d_{13} & d_{14} & d_{15} \\ d_{21} & d_{22} & d_{23} & d_{24} & d_{25} \\ d_{31} & d_{32} & d_{33} & d_{34} & d_{35} \\ d_{41} & d_{42} & d_{43} & d_{44} & d_{45} \end{vmatrix} = (D'_1, D'_2, D'_3, D'_4, D'_5) \text{ (eqn. 5.13)}$$

Using the generated weighting function set estimated through Eqn. 10, where $\bar{D}_i$ represents the fuzzy evaluation matrix or the membership functions for the procurement stages $(i.e., D'_1, D'_2, D'_3, D'_4, D'_5)$, the fuzzy matrix can be quantified using the selected grade alternative (L=1,2,3,4,5) using the formula below:

$$\sum_{k=1}^{5} \bar{D} \times L^t = (D'_1, D'_2, D'_3, D'_4, D'_5) \times (1,2,3,4,5) \quad 1 \leq \text{CVI} \leq 5 \qquad \text{(eqn. 5.14)}$$

$$\bar{R} = \begin{vmatrix} 0.271 \\ 0.257 \\ 0.181 \\ 0.290 \end{vmatrix} = \begin{vmatrix} 0.13 & 0.14 & 0.18 & 0.37 & 0.19 \\ 0.06 & 0.07 & 0.17 & 0.43 & 0.27 \\ 0.11 & 0.16 & 0.19 & 0.41 & 0.14 \\ 0.07 & 0.12 & 0.20 & 0.43 & 0.18 \end{vmatrix} = (0.09, 0.12, 0.19, 0.41, 0.20)$$

$$PVI_{overall} = [(0.09 \times 1) + (0.12 \times 2) + (0.19 \times 3) + (0.41 \times 4) + (0.20 \times 5)] = 3.54$$

5.3.7 Development of the Procurement Vulnerability Model

In developing the procurement vulnerability model, the vulnerability index for each of the constructs is merged to develop a linear equation model. The technique is adopted due to its ability and flexibility to allow for different ordinal grading scales (i.e., either 9, 7 or 5-point scale to be used in assessing the vulnerability index of procurement processes in developing countries, which share similar characteristics with Ghana. Moreover, another advantageous justification for adopting the linear model approach is that it is clear, concise, logical, and easily understandable. It, therefore, allows practitioners, policymakers, anti-corruption institutions, and researchers to adopt or use it without difficulty.

However, prior to the development of the linear model for the evaluation of the overall procurement vulnerability index for infrastructure projects in Ghana or other developing regions, it was needful to normalize the individual procurement vulnerability index of the procurement stages in order to equate the summation of all the constructs to one (Osei-Kyei and Chan 2017). This can enable the evaluation or the estimation of any of the overall procurement vulnerability index of either a proposed or existing project irrespective of the grading scale of linguistic terms adopted. **Table 5.4** presents the normalized values of the procurement constructs.

Table 5.4: Stages of the Procurement Process

Code	**IP Stages**	**Weighting**	**Coefficients**	**Coefficient Symbols**
PSC	Pre-Contract stage	3.34	0.240	C_{psc}
CTS	Contract Stage	3.77	0.271	C_{cts}
CAS	Contract administration stage	3.30	0.237	C_{cas}
PCP	Post contract phase	3.51	0.252	C_{pcp}
	Total	13.92	1.000	

Therefore, using the normalized values, the linear equation model of the estimation of the overall PVI for IP's in Ghana or other similar developing countries is presented below:

$$PVI_{overall} = C_{psc}[PCS] + C_{cts}[CTS] + C_{cas}[CAS] + C_{pcp}[PCP] \quad \text{(eqn. 5.15)}$$

$$= 0.240[PCS] + 0.271[CTS] + 0.237[CAS] + 0.252[PCP]$$

In equation 5.15, the coefficients assigned to each procurement construct correspond with their respective normalized values and according to the equation. CAS turned out to be the construct with the highest coefficient value followed by PCP due to their respective high weightings obtained from the FSE technique.

5.4 Discussion

The indexes obtained from the FSE technique for each of the procurement constructs or stages explicitly revealed two out of the four constructs to be vulnerable to corrupt practices. They are the contract stage and post-contract stage. However, some of the vulnerability indexes of the individual activities within the specified constructs vary. Hence, whereas activities such as the preparation and signing of the contract may regarded as less vulnerable even though its respective construct (i.e., the contract stage) is determined to be vulnerable, activities such as the solicitation of tenders is regarded to be one of the highly vulnerable activities to the incidence of corrupt practices even though its respective construct (i.e., pre-construct stage) is identified to be relatively less vulnerable. A further discussion on each of the constructs or stages is subsequently presented.

5.4.1 The Pre-Contract Stage

The pre-contract stage encompasses the definition of the project to be constructed through to the receipt of tenders (Ruparathna and Hewage, 2013). However, other practices regarding a specific project may conduct the pre-tender meeting to establish the evaluation criteria that would be employed to assess tenders received (Lester, 2007). Therefore, CTS1 can be captured under PCS, depending on the project plan. The susceptibility index recorded at this stage is identified to be relatively low, mainly due to the limited number of parties involved at this stage as compared to the other constructs. However, despite

the low-level index recorded by the construct, two activities out of the six under this construct were identified to be vulnerable to corrupt practices. They are the solicitation of tenders, which also happened to be the highest susceptible activity under the PCS construct and second highest in terms of the vulnerability indices of all the 21 activities of the procurement process. At the pre-contract stage, most of these risks are initiated by the client's representatives or parties within the sourcing board. In the public domain, it is often instigated by a government official who serves as representatives (Le et al., 2014). Government officials are frequently reported to be major contributors to the proliferation of corruption in the public sector and at this particular stage of the procurement process (Owusu et al., 2017). The penultimate susceptible activity recorded at this stage is the obtaining of the required approvals (PCS4) either needed to commence a project's execution or during execution. A respondent reported on the proliferation of collusion (regarded as a fraudulent act often characterized by the undisclosed arrangement among a group of projects' representatives who meet to conspire to commit a deceitful act with the primary aim of obtaining illegitimate benefits such as financial gains (Chan and Owusu, 2017) at this stage. However, this identified shortfall was not attributed to a specific activity but as a general issue within the pre-contract stage.

5.4.2 The Contract Stage and the Contract Administration Stage

The contract stage was found to be the most susceptible stage of the procurement process to corruption, as indicated by the respondents. This stage covers activities ranging from the pre-tender meeting to the evaluation of retrieved bids as well as the selection and the award of the contract to the suitable contractor. The activities within this construct obtained relatively higher vulnerability indexes, making the CTS construct the most vulnerable procurement process in developing countries. Some identified risk factors such as conflict of interest, bid suppression and rotation, cover bidding, cartels, ghosting, and bid-rigging are manifested at this stage and during the execution of the individual activities (World Bank, 2013). The causal factors underpinning the incidence of these variants of corrupt acts can be attributed to project-specific causes such as the lack of proactive mechanisms to stop or limit the proliferation of corrupt acts over competition in the tendering process, overclose relationship and weak procurement structures among many others (Owusu et al., 2017; Zhang et al., 2017; Le et al., 2014).

Due to the high level of susceptibility, both the fuzzy weighting and the model coefficient for the CTS construct were calculated to be 3.77 and 0.271 (more than a quarter percentage out of four constructs). These values were identified to be the highest estimated values at both levels. In effect, any development of anti-corruption measures aimed at expurgating corrupt practices in the procurement process should consider targeting and expending greater efforts at the contract and post-contract phases as compared to the other two. This will either save time or create more time as well as allow the maximum output of the expended efforts and resources.

As explained earlier, the contract administration stage consists of four distinct but interrelated activities. This stage can also be termed as the post-tender or the contract management stage (Park and Kim 2018). In descending order of highly susceptible activities, the topmost is the administration of progress payments with a mean index of 3.39, monitoring of project's progress, 3.39, issuing of contract amendments, and the follow up of project delivery with mean indexes of 3.13 and 2.97 respectively. The overall fuzzy index generated for the construct was 3.30, which indicates moderate or neutral vulnerability. Given the overall index, it must be emphasized that this particular construct is as well vulnerable to the incidence of corrupt practices, although moderately. Therefore, in advancing strategic measures to curb the incidence of corrupt practices should not only consider the vulnerable stages (i.e., the contract and the post-contract stages) but also on reducing both the index and the real-life incidence of the varying forms of corrupt practices at this stage of the procurement process with their respective causal instigators.

5.4.3 The Post Contract Stage

The post-contract stage was identified to be the second-highest susceptible construct. The respective overall index and associated model coefficient values were 3.51 and 0.252. This depicts more than 25% of the overall susceptibility index of the procurement process. The activities within the PCP construct that render the entire construct vulnerable to the incidence of corrupt practices include the checking of

proof for delivery and the issuance of the final contractual amendment and the completion of final audits, among other activities.

Even though there are wide reported cases and studies on the causal factors and the associated effects of corrupt practices in the procurement process, only a few efforts have been made to research the specificity of the procurement activities and their relationships with various constructs under the subject of corruption (Owusu et al., 2017). Consequently, it is extremely challenging to make determinations and estimations on the degree of corrupt practices (Shan et al., 2015; Ameyaw et al., 2017). This is because, whereas the practices of corruption are constantly evolving, resulting in new forms and their associated causal factors, there is an unparalleled development of calculative measures instigated and enforced to curtail their incidence and effects (Chan and Owusu, 2019; Bowen et al., 2012). In other words, the current anti-corruption measures or frameworks may not be comprehensive enough to exterminate the specific forms or corruption at the specific stages of the procurement process. Therefore, even though there are several policies and stipulations on the entire procurement process that guide different jurisdictions, studies on measures developed to specifically target the expurgation of the proliferation of corrupt practices as well as the susceptibility of the procurement process remain limited (Owusu et al., 2018; Shan et al., 2017). Per the results, not only do the stages or constructs of the procurement process vary in terms of their degree of susceptibility and the proliferation of corruption but also terms of the corrupt activities prevalent within the stages (Stansbury and Stansbury, 2008; Chan and Owusu, 2017). Therefore, this study maintains that the development of anti-corruption measures and frameworks towards the annihilation of variants of corrupt practices in the procurement process should be specific and directed towards the individual procurement activities rather than being generic.

Regarding the decision to contract stage, Ferewer et al. (2017) pointed out that while this stage is intended to facilitate the decision to procure the needed goods, works, and services, there is a high tendency to deviate from the policy rationale or the actual need to procure. The deviation is therefore aimed at creating a possible outlet to illegally channel resources or benefits either to an organization or the parties behind the act (OECD, 2007; Ferewer et al., 2017; Owusu et al., 2017). One key indicator

that was identified at the requirement definition stage was the tendency for project consultants or public officials to design the tender to suit a favorite bidder since the procurement process design is formulated by these parties (Ferewer et al., 2017; Stansbury and Stansbury, 2008; Sohail and Cavil, 2007; Tabish and Jha, 2008).

As a result, the entire tendering process is secretly distorted. According to Soreide (2002), it is not uncommon for public officials to decide which person or firm gets invited to tender in a competitive bidding procurement system. This, results in diverse forms of discriminatory, corrupt practices including favoritism, cronyism, nepotism, and patronage among other forms of corruption (Chan and Owusu, 2017; Brown and Loosemore, 2016; Bowen et al., 2012). These forms of corrupt practices often manifest in the procurement process as a result of some critical causal factors including the complex nature of projects (Owusu et al., 2017; Krishnan, 2009), fierce competition (Le et al., 2016; Zhang et al., 2017), complex contractual structure (18;34), overclose relationship (Ling et al., 2014; Chan et al., 2003), and the inadequate proactive measures to mitigate corruption especially in developing countries like Ghana (Ameyaw and Chan, 2017). Regarding the remaining phases (i.e., from the contract administration stage to the post-contract stage), diverse examples triggered by their unique causal instigators have been identified by different studies in different contexts. For instance, at the pre-qualification and tender phase, the noted examples which corroborate the views of experts were price-fixing, bid-rigging, and unreasonably shorter bidding time. Others included inadequate tender advertisement, ghosting, and influence peddling (Chan and Owusu, 2017; Ameyaw et al., 2017; Le et al., 2014; Locatelli et al., 2018).

5.5 Chapter Summary

This chapter examined the susceptibility of the procurement process of infrastructure-related projects in Ghana using the FSE technique. The study aimed to ascertain the extent to which the activities within the procurement process get exposed to corruption. This is aimed at advocating for more specific and comprehensive efforts can be taken to address the vulnerability level of each of the activity within the

process. It also aimed at developing an assessment tool for determining the vulnerability indexes of projects. The results obtained were not altogether unsurprising as Ghana is regarded by several measurement indexes such as the corruption perception index (CPI) by the Transparency International (TI) as one of the neutrally corrupt countries regarding the proliferation of corrupt practices in the public sector. This study contributes to the body of knowledge on corruption, and particularly in the field of construction management, by examining the vulnerabilities of projects' procurement process to the incidence of corrupt practices in the developing countries. The study further established the indexes for the individual procurement stages, thereby informing researchers and practitioners about how prone the stages are regarding corruption and their respective contributions towards the overall estimation of the vulnerability index. The weightings of the stages were normalized to facilitate the development of the linear model, which can be adopted to estimate the vulnerability index of existing or proposed projects. This can enhance the facilitation process of predicting how susceptible projects are to corruption and the necessary measures to take to limit or expunge corruption in Ghana and other developing countries.

Generally, the most common techniques for measuring corruption adopts the solicitation of the general perception using the average or mean ratings to indicate the levels of criticalities. This study employed the FSE technique to examine the vulnerability of corruption in project procurement as well as develop a linear measurement model for estimating and predicting the vulnerability index of proposed or existing projects - the first of its kind to be conducted and reported in the field of construction management. The results also indicate that the activities undertaken at the contract stage should be given attention to reducing the number of risk indicators that could potentially expose a proposed or an ongoing project to corruption. This study contributes to the body of knowledge on the ways of measuring the various indicators of corruption in infrastructure procurement and is, arguably, the first to employ soft computing techniques (i.e., the FSE approach) to estimate the susceptibility patterns of the various stages of the procurement process as well as develop an easy to adopt-and-use, yet standardized approach to facilitate similar estimations in future works. Practically, the model understandable and can be adopted by practitioners such as policymakers and auditors for detecting and measuring the vulnerability indexes of various procurement activities and their respective stages of the

procurement process to the incidence of corruption. The model can as well form the basis for researchers to develop more comprehensive tools that extend beyond the boundaries of the procurement process for predicting, measuring, and offering effective measures for corrupt practices right from the definition of project's requirements through to project execution to contract close-out. Lastly, this study contributes to a more deepened understanding of the various means of measuring corruption in the domain of project procurement and management.

CHAPTER 6 – MEASURING THE CRITICALITIES OF THE NEGATIVE CONSTRUCTS OF CORRUPTION AND THEIR IMPACT ON THE PROCUREMENT PROCESS[10]

6.1 Introduction

This section examines the criticalities of all the negative indicators within the procurement process. Thus, while the previous chapter examined how vulnerable the activities and the stages within the procurement process are to corruption, this chapter examines how the negative indicators take advantage of the susceptibility attributes of the procurement process and impact the procurement process negatively. As mentioned earlier, the negative constructs explored in this study are the causal indicators of corrupt practices, the procurement irregularities of risk indicators, and lastly, the barriers that inhibit the efficacy of the procurement process. All these constructs are made up of their categories and variables. However, to ascertain the significance of the contributory effects of these negative constructs on the procurement process, the relational assessment conducted in this study makes use of the variables rather than the categories. Thus, the empirical explorations of all the variables within their respective constructs are examined first and later assessed in relation to the procurement process. The next sections are therefore discussed in the following order: 1) the causal indicator of corruption, 2) procurement irregularities or risk indicators of corruption, and 3) the barriers that hinder the efficacy of the enforced anti-corruption measures.

6.2 Forms of Corruption

As described in the literature review section (chapter3), twenty-eight different forms of corrupt practices were identified via a thorough literature review. However, twenty-seven were noted to be noticeable in public projects executed the developing context. The only form of corruption that was excluded in the case of the developing was 'Guanxi' which is typically affiliated to the Chinese construction public

[10] Owusu E. K, Chan A. P. C (2019). Investigating the Criticalities of Corruption Forms in Infrastructure Projects in the Developing Context. Construction in the 21st Century (CITC). 9-11 September 2019, *United Kingdom.*

sector (Le et al. 2014). Thus, while the experts involved in the pilot survey recommended the deletion of any factor that does not relate to the context under study, it was also obvious that the term 'guanxi' is a Chinese term and does not apply to any other context. The twenty-seven forms are presented in Table 6.1

The categories developed in the third chapter of the study were maintained to ensure consistency. As a result, the five main constructs, in addition to the unclassified conduct, were empirically assessed. They are; bribery acts, collusive ads, fraudulent acts, discriminatory acts, and extortion acts. All these constructs are made up of at least three variables, and except the conduct of extortion any act, all the remaining constructs were noted to have at least two critical variables. The criticalities of the individual variables are therefore explicated with their respective constructs. The constructs are therefore discussed in descending order of their criticalities. Lastly, their impacts or influence at the various sections of the procurement processes of both contexts are presented in Chapter 8.

Table 6.1: Forms of corruption variables

No.	Variables	Mean	N-Value	Sig	SD	Overall Rank	Construct Rank
1.	Bribery	4.02	1.00	0.000	1.118	1	1
2.	Lobbying	3.81	0.76	0.000	1.069	2	2
3.	Facilitation payments	3.79	0.74	0.000	1.175	4	3
4.	Kickbacks	3.74	0.68	0.000	1.241	7	4
5.	Solicitation	3.66	0.59	0.000	1.280	9	5
6.	Influence peddling	3.65	0.57	0.000	1.216	10	6
7.	Front/shell companies	3.63	0.55	0.000	1.244	11	1
8.	Collusion	3.58	0.49	0.000	1.033	14	2
9.	Fraud	3.53	0.44	0.003	1.376	15	3
10.	Ghosting	3.52	0.43	0.001	1.198	17	4
11.	Dishonesty	3.44	0.33	0.007	1.236	18	5
12.	Deception	3.37	0.25	0.020	1.218	20	6
13.	Money laundering	3.27	0.14	0.129	1.405	23	7
14.	Price fixing	3.81	0.76	0.000	.989	3	1

15.	Bid rigging	3.76	0.70	0.000	1.141	5	2
16.	Cartels	3.26	0.13	0.081	1.144	24	3
17.	Coercion	3.34	0.22	0.047	1.318	21	1
18.	Blackmail	3.29	0.16	0.086	1.311	22	2
19.	Extortion	3.24	0.10	0.125	1.224	25	3
20.	Client abuse/clientelism	3.19	0.05	0.223	1.239	26	4
21.	Intimidations and threats	3.15	0.00	0.327	1.157	27	5
22.	Favoritism	3.68	0.61	0.000	1.170	8	1
23.	Nepotism	3.58	0.49	0.000	1.181	13	2
24.	Patronage	3.44	0.33	0.007	1.223	19	3
25.	Conflict of interest	3.74	0.68	0.000	1.130	6	1
26.	Embezzlement	3.61	0.53	0.000	1.077	12	2
27.	Professional negligence	3.52	0.43	0.004	1.352	16	3

6.2.1 Bribery Acts

Albeit, bribery acts' construct was not anticipated to emerge as the most critical construct especially when the entire construction and procurement activities and stages are identified and reported to be plagued with collusive and fraudulent acts (Shan et al. 2017). However, the bribery acts' construct was revealed to be the most critical construct among all the forms of corrupt practices. It also emerged as one of the two constructs with their entire variables identified or noted to be critical. However, unlike the results ascertained in Chapter 3 regarding the most discussed construct of corruption forms, the bribery acts construct was identified to be the third most discreet construct. Thus, inasmuch as other constructs are widely discussed as compared to the bribery construct, the bribery construct was empirically identified to be the most critical in the context of the deve-loping countries such as Chana (Owusu et al. 2019). Bribery identified to be the most critical with a criticality index of 4.02. This was succeeded by lobbying, facilitation payments, kickbacks, solicitation, and influence peddling with their criticality indexes at 3.81, 3.79, 3.74, 3.66, and 3.65, as indicated in Table 6.1.

The realization of the bribery acts" construct was not all surprising as the construct and its attributes are noted to be the most long-standing variants of all forms of corruption (Noonan 1984). Moreover, the form 'bribery' was assessed by the experts to be the most critical form of corruption, not only under its construct but also among the entire twenty-seven forms of corrupt practices. The promising and offering of rewards (most typically, in monetary terms) to entice officials with delegated authority is a common practice in the Ghanaian public project processes (Ameyaw et al. 2017). And as indicated, this is expressed in the other forms, such as lobbying (distorting or negatively influencing, the policies of an institution to one's favor), facilitation or grease payments and kickbacks (Chan and Owusu 2017). However, inasmuch as these forms have been indicated or identified to be the most critical in the developing context, their generic criticalities may be argued out to be a common knowledge which does not contribute that much toward the extirpation of their influence and negative impacts in the modus operandi of the processes involved in a project. Future studies can examine their criticalities at the different stages of the project processes and the mechanisms needed to limit the irregularities and the opportunities that create room for any of these forms of corrupt practices. However, this recommendation does not only apply to this construct (i.e., the bribery acts' construct) but all the other forms of corrupt practices.

6.2.2 Collusive Acts

As indicated in Chapter 3, inasmuch as the construct of collusive acts tends to be a stand-alone construct, it is viewed by different scholars and reports as the most mentioned form of fraudulent acts. Thus, these two are correlated with each other as collusive practices fall under the construct of fraudulent practices (Chan and Owusu 2017). With an overall criticality index of 3.61, three main forms are captured under this construct, namely price-fixing, bid-rigging, and the influence of cartels. However, two out of the three forms were revealed to be critical, as assessed by the experts involved in the survey. They are 1) price-fixing, with a criticality index of 3.81 followed by bid-rigging with a criticality index of 3.76. Inasmuch as these variables or forms have been indicated by the experts to be critical, one will hardly find forms like price-fixing or cartels being reported in the news due to the subtle or clandestine nature

as well as the ingrained endemic culture of corruption within the project-context of most developing countries such as Ghana (Damoah et al. 2018; Ameyaw et al. 2017). Taking price-fixing as an example, unless any of the members within the cartel is willing to betray the rest of the team responsible for fixing prices, it is often difficult or challenging to discover such acts.

It is, however, obvious that these forms of corrupt acts are often prevalent at the pre-contract stage of a project where tenders are advertised and solicited (Owusu et al. 2019). Thus, measures taken towards the extirpation of collusive practices may consider not only the generic connotations and incidences but also the specific stage and activities within which these forms occur. For instance, given that bid rigging occurs when consenting parties (from both the consulting and contracting teams) meet to settle on the bid results beforehand, how can this be stopped? Or what mechanism can be established to limit the opportunities that create room for corrupt practices of this nature to happen? Adopting transparency mechanisms have been suggested as one of the good approaches to limit such acts. However, the adoption and modes of applications remain challenging, again due to the clandestine nature of corrupt practices.

6.2.3 Discriminatory Acts

As the name implies, discriminatory acts refer to the acts of demonstrating prejudicial disparities in favor of one party against the other (Chan and Owusu 2017). Predominantly in projects, discriminatory acts take place when projects are awarded unfairly to other unqualified parties as a result of existing ties or relations. (Chan and Owusu 2017). Again, three different forms were captured under this construct, namely favoritism, nepotism, and patronage rain out of the three, the first two were identified to be critical, and patronage revealed to be moderately critical. While other works record cronyism (showing favoritism to friends and colleagues without following necessary principle or qualifications) as one of the dominant forms of corruption, this research acknowledges cronyism as a synonym of favoritism while nepotism deals with the unfair award of a privilege or a benefit to a relative or a friend.

On a larger scale, cases on the unfair award of contracts due to favoritism or nepotism are not uncommon in developing countries such as Ghana. In 2017, a case was recorded where a chief executive officer of a public office awarded eleven contracts to a very close relative (Joy 2018). The question regarding how the acts of favoritism can be limited also poses a challenge in helping solve the issue of corruption in general. This is because, as a psychological issue, personal greed has been identified as the leading cause of corruption despite the creation of systematic and organizational irregularities (Owusu et al. 2017; Le et al. 2018). And since greed is often ingrained in humans who constitute the decision-making teams at the government, project, and organizational levels. Moreover, since it is often difficult to alter the behavioral makeup of a person, an effective proposition to limiting these kinds of events will be to investigate into a more transparent mechanism that can ensure the effective and unbiased award of contracts.

6.2.4 Fraudulent and Extortionary Acts

Fraud means deception or deceit. Fraudulent acts can, therefore, be termed as cheating or corrupt acts where the corrupt party deceives another to obtain an illegitimate favor or other monetary rewards (Chan and Owusu 2017). Seven different forms were captured under this construct, namely, front/shell companies, collusion, fraud, ghosting, dishonesty, deception, and money laundering. However, out of these seven, the first four were identified to be critical, and the last three determined to be moderately critical. As mentioned, some of the fraudulent acts in their very nature have remained very ruinous and difficult to extirpate. Typical examples are what have been discussed at the collusive act's section, such as bid-rigging and price-fixing and others highlighted in this section, such as front companies (i.e., a shell company without a physical presence but are formed to cover the parent company from liability) and ghosting. These kinds of acts or practices are heavily predominant in a secrecy or tax haven jurisdiction, and the primary aim is to shield the actual beneficial owner from taxes, disclosure, or both. Moreover, the act of bid-rigging has also been noted as one of the causal factors of other forms of corruption, such as the offering of bribes or facilitation payments (Chan and Owusu 2017). Thus, it can be argued out that the development and enforcement of adequate measures to check bid-rigging can

help to either reduce or eliminate the incidence and proliferation of some of the critical forms at both the pre-contract and the contract stages of the procurement process where all the opportunities and possibilities or rigging the bid process is possible.

6.2.5 Unclassified Acts (Professional Malfeasance Acts)

This construct contains stand-alone variables. Thus, as explicated at the literature review section, the construct was labeled unclassified because a common name for this construct is yet to be developed. Three variables were captured under this construct, and they were all revealed to be critical in the developing context. According to the rating of the experts, the three variables captured under this construct together with their criticality indexes are 1) conflict of interest being noted as the most critical variable under this construct with a criticality index of 3.74 2) embezzlement with a criticality index of 3.61 and 3) professional negligence also with a criticality index of 3.52. Conflict of interest, which is reported to be a common practice in the developing context, was identified to be the most critical CF within this construct (Owusu and Chan 2019). According to ACD (2013), conflict of interest encapsulates three core elements namely 1) the primary interest (what needs to be achieved for the client), 2) the secondary or private interest (the interests of the individual or party offering services to a client which often creates room for the conflict and 3) the conflict itself.

Thus, given these three elements, a conflict of interest can occur in a scenario where a contractor responsible for executing a public project (a primary interest) compromises on either the allotted time or budget for completion to satisfy his interest (secondary interest). There are situations where more often than not, the conflict noes not necessarily compromise of the primary interest as indicated in the given analogy by rather creates a situation where the need for getting the primary interest gets abandoned or neglected (ACD 2013). Inasmuch CFs such as conflict of interest may not necessarily engage all the three most active players of corruption (i.e., the demand side, the supply side, and the condoning side), there is the need to determine possible areas of construction activities or processes that

may be susceptible to the incidence of conflict of interests in order to draw proactive mitigation strategies to limit their incidence (ACD 2013; Le et al. 2014b; Owusu et al. 2019).

The other forms captured under this construct, namely embezzlement and professional negligence, share some common characteristics with conflict of interest in that all the three classes of corrupt parties are not supposed to be present for these forms of corruption to occur. In essence, one party (the corrupt party) is the key player in all three forms of corruption captured under this construct. For instance, unlike bribery, collusive and discriminatory acts where there should be at least two consenting parties, the forms under this construct epitomizes the misappropriation of power by just in an individual with either absolute or delegated authority. In the instance of embezzlement, a single person holding an either an authoritative or a delegated power (i.e., either project managers or employees) position illegally uses, misappropriates, or traffics the resources entrusted in his care but intended for completing the project for his personal interest (TI 2019). Again, similar to the conflict of interest, the acts of embezzlement also distort or compromise on the actual intended purpose of the projects' resources (TI 2019). The same goes for professional negligence, where a careless act of a professional creates a vulnerable room for the intended purpose of project resources to be misappropriated (Chan and Owusu 2017). However, unlike the first two variables where the actors or professionals involved are mostly intentional about engaging in such acts, professional negligence can either be intentional or unintentional. Thus, the development of effective measures to curb the incidence and proliferation of these forms may consider not only the intended negative acts from the professionals but also the proactive measures to extirpate or mitigate the unexpected shortcomings of professionals that carry the potency of distorting any of the processes involved in a project.

6.2.6 Extortionary Acts

Extortionary acts that can be defined as forceful practices of obtaining illegal favors, rewards, or gains ranked last among the other constructs in this section. Since it was noted as one of the constructs with at least five variables, none of the variables was identified to be critical. Simply put, while corruption remains a critical problem and concern in the developing world, the results indicate that the nature of

corrupt acts prevalent in the developing contexts is sometimes subtle rather than forceful. The variables captured under this construct are coercion, blackmail, extortion, client abuse/clientelism, intimidations, and threats with their criticality indexes revealed to be moderate within the range of 3.15 and 3.34.

Moreover, the power balance that exists among the various parties forming the project team limits the opportunity for a project party to forcefully abuse his delegated authority even though he can secretly abuse it. Thus, the results are seen to be unsurprising as extortionary cases are uncommon in some parts of the developing context such as Ghana and are also hardly reported in the news. However, despite the low rates of criticalities recorded by the individual variables, reported measures that can increasing limit the incidence and proliferation of such acts are: 1) continual raising of awareness of corruption and one's rights in a contractual environment, 2) proactive administrative measures to extirpate the creation of opportunities for such acts and 3) reactive measures to extend necessary charges and due penalties for such acts (Owusu et al. 2018). The criticalities of the individual constructs have been presented in Fig. 6.1.

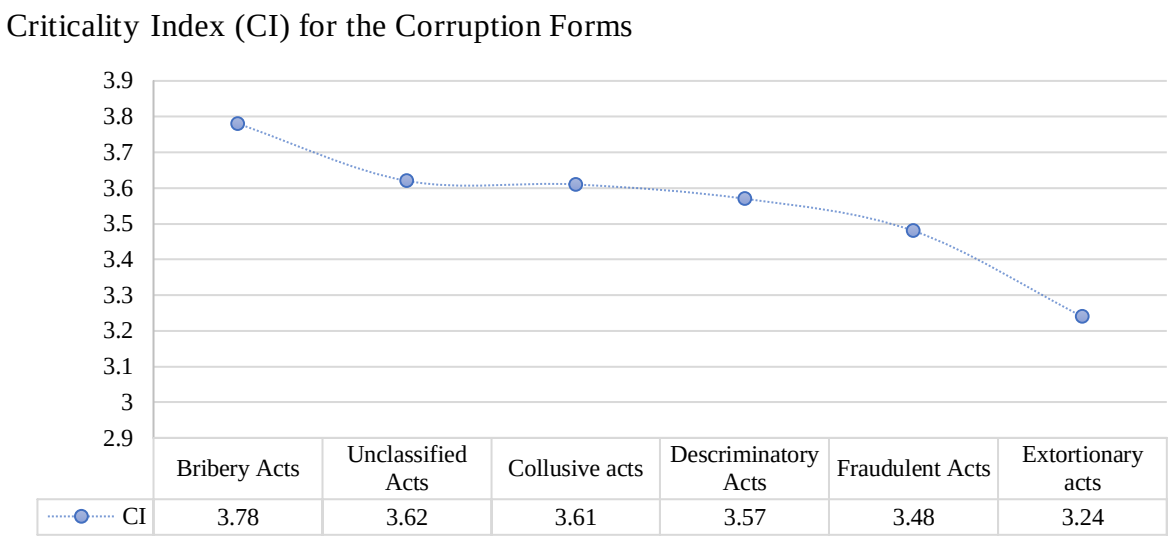


Figure 6.1: Graphical presentation of the criticalities of Corruption Forms Constructs

6.3 Causal Factors of Corruption

As explained in chapter 3, the causal factors of corruption refer to the causal agents that instigate or give rise to corruption. This section of the chapter, therefore, aims to examine the criticality of the causal factors of corruption in infrastructure-related works and their respective impacts on the

procurement process. Following an extensive review (Chapter 3), 38 causal factors were examined first to highlight their levels of criticalities, and second, reveal their impact throughout the procurement process made up of 21 activities captured under four stages. The experts involved in the survey were asked to rate the criticality of the causal factors. The 38 individual variables are captured under five main categories, namely Psychosocial-Specific Causes (PSSC), Organizational-Specific Causes, Statutory-Specific Causes (SSC), Regulatory or Legal-Specific Causes (RSC) and Project-Specific Causes (PSC). **Table 6.1** is presented to give an overall summary of the variables and their respective constructs. This section aims to make a theoretical contribution to the scholarship of construction and project management-related scholarships by offering a deepened understanding of corruption-related studies regarding the critical causal factors that distort the construction-related processes. Additionally, the study reveals the critical activities and stages of the procurement process that are affected most by the established causal factors. Practically, the findings of this study are highly relevant to the project stakeholders, policymakers, anti-corruption institutions, and activists in developing countries as it informs them about the critical causal factors within the procurement process to expurgate. It also informs them about the vulnerable stages of the procurement process that requires necessary reinforcement to make the entire process resilient to the pervasiveness and impacts of corruption.

Table 6.2: Criticalities Estimations of the corruption causal variables

Code	Variables	Mean	N-V	OR	CR	Criticality
PSSC	***Psychosocial-Specific Causes (PSSC)***	***3.61***				***High***
CC 1	Personal greed	3.92	1.00	1	1	High
CC 6	Over close relationship	3.71	0.77	6	2	High
CC 9	Negative role models	3.66	0.71	9	3	High
CC 14	Poor professional ethical standard	3.60	0.64	14	4	High
CC 35	Feeble semblance of public interest	3.16	0.16	35	5	Moderate
OSC	***Organizational-Specific Causes***	***3.43***				***Moderate***
CC 2	Inadequate sanctions	***3.77***	0.83	2	1	High
CC 11	Lack of a positive industrial climate	3.61	0.66	11	2	High
CC 12	Poor documentation of records	3.61	0.66	12	3	High
CC 15	Delaying the payment of workers" salaries	3.56	0.60	15	4	High
CC 20	Over competition in tendering process	3.50	0.53	20	5	High
CC 23	Low wage level	3.50	0.53	23	6	High

CC 27	Economic survival	3.40	0.42	27	7	Moderate
CC 30	Complexities of institutional roles and functions	3.29	0.30	30	8	Moderate
CC 32	Absence of effective and responsible administrative systems	3.26	0.27	32	9	Moderate
CC 33	Fierce competition	3.24	0.24	33	10	Moderate
CC 38	The nature of corruption being a secret activity	3.02	0.00	38	11	Moderate
SSC	***Statutory-Specific Causes (SSC)***	***3.58***				***High***
CC 4	Lack of coordination among Government departments	3.71	0.77	4	1	High
CC 5	Inappropriate political interference	3.71	0.77	5	2	High
CC 18	Subjecting workers to Job insecurity, especially in government and public enterprises	3.52	0.56	18	3	High
CC 19	Transition of government	3.52	0.56	19	4	High
CC 25	Appointment of a local representative who acts on behalf of the firm to obtain contracts	3.45	0.48	25	5	High
RSC	***Regulatory or Legal-Specific Causes (RSC)***	***3.48***				***High***
CC 3	Flawed regulation system	3.74	0.80	3	1	High
CC 7	Lack of legal awareness	3.69	0.74	7	2	High
CC 10	Insufficient legal punishment and penalties	3.66	0.71	10	3	High
CC 21	Multifarious license or permits	3.50	0.53	21	4	High
CC 24	Absence of project anti-corruption systems	3.48	0.51	24	5	High
CC 26	Absence of control mechanism	3.44	0.47	26	6	Moderate
CC 29	Deficiencies in rule and laws	3.29	0.30	29	7	Moderate
CC 31	Deregulation in the public construction	3.27	0.28	31	8	Moderate
CC 34	Weak procurement/contractual structures	3.23	0.23	34	9	Moderate
PSC	***Project-Specific Causes (PSC)***	***3.44***				***High***
CC 8	Lack of rigorous supervision	***3.69***	0.74	8	1	High
CC 13	Lack of pro-active steps by funders to limit corruption on projects	3.60	0.64	13	2	High
CC 16	Asymmetric information amongst project parties	3.55	0.59	16	3	High
CC 17	Great project complexity	3.55	0.59	17	4	High
CC 22	Insufficient transparency in the selection criteria for tenders	3.50	0.53	22	5	High
CC 28	Lack of frequency of projects	3.30	0.31	28	6	Moderate
CC 36	Complex contractual structure	3.15	0.14	36	7	Moderate
CC 37	The nature of infrastructure	3.14	0.13	37	8	Moderate

Note: N-V represents Normalized Values; OR represents overall rank; CR represents construct rank.

The Psychosocial-Specific Causes (PSSC) in this context simply refers to the relational interactions of social and psychological factors and the outcome or influence in a given setting (e.g., the workplace) or

on the modus operandi of a work execution (Greitzer 2013; Heiser 2001). A recent review conducted by Owusu et al. (2017) identified the variables within this construct to be the most discussed in the extant scholarship of construction project management. The results obtained in this study do not deviate from the position regarding the criticality of this construct as it was evaluated to be the most critical construct with a mean index (MI) of 3.61. In agreement with the construct criticality, the respondents evaluated the variables under this construct to be the most pressing causal factors of corruption in construction projects. Thus, reechoing the need to pay more critical attention in examining the entire construct and the variables within it to develop more stringent anti-corruption tools and measures potent and resilient enough to extirpate their criticalities, particularly in the developing context. From the estimation of the experts, four out of the five causal factors captured under this construct were noted to be critical. Personal greed (CC1) was evaluated as the most critical variable among all the 38 causal factors, with a mean index (MI) of 3.92. The remaining critical factors were over-close relationship (CC6), Negative role models (CC9), and poor professional, ethical standard (CC14) with their respective MI as 3.71, 3.66, and 3.60.

Statutory-Specific Causes (SSC) came second to PSSC as the second most critical construct in the developing context, with an overall MI of 3.58. According to Owusu et al. (2017), SSC is government-driven forces that instigate the incidence and proliferation of corruption. Given that the definition of corruption is often attributed to the misappropriation of a State's resources, the government is seen as the most vulnerable areas to high-level corruption (Johnston 2017). Albeit this construct was identified to second most critical, unlike PSSC, all the five variables captured under this construct were identified to be critical. With the first two variables obtaining the same MI of 3.71, the respondents revealed that the inappropriate interferences political influences in public projects (CC5) and the lack of coordination among government departments responsible for a given public project (CC4) were noted as the most critical factors under this construct. The remaining variables which were subjecting public workers to Job insecurity, especially in government and public enterprises (CC18), change of government (CC19) and the appointment of unqualified local representative who acts on behalf of the firm to obtain contracts (CC25) obtained MI of 3.52, 3.52 and 3.45 respectively.

Anytime there is an ethical dilemma regarding a person and his or her environment or the state, the usual link that commonly found between these two subjects is the compliance to law or regulations binding them. It was, therefore, unsurprising to identify regulatory or legal-Specific Causes (RSC) as the third critical construct among the five with a construct MI of 3.48. Regulations simply refer to acts, directives, norms or principles for guiding a process or an object to conform to the acceptable standards required. Thus, regulatory-specific causes can be defined as loopholes in guiding principles or the partial inclination to the demands of a regulation that result in corruption in the long run. The RSC construct is made up of nine unique variables, and out of these nine variables, five were evaluated to be critical, and the remaining four to be moderately critical. With flawed regulation system (CC3) emerging as the most critical variable with an MI of 3.74, the other four critical RSC variables were 1) the lack of legal awareness either in a project setting or a contractual environment (CC 7) with an MI of 3.69, 2) insufficient legal punishment and penalties (CC10) with an MI of 3.66, 3) multifarious license or permits (CC21) obtaining an MI of 3.50 and 4) the absence of project anti-corruption systems (CC24) with an MI of 3.48.

Even though most projects in the developing world are often susceptible to corruption due to the causal factors captured under the construct of Project-Specific Causes (PSC) as well as the other causes identified under the other constructs, the PSC construct was evaluated or revealed by the respondents to be moderately critical with an MI of 3.44. PSC can be defined as the project-oriented loopholes that instigate corruption during the planning, procurement, and management of construction projects (Le et al. 2014; Owusu et al. 2017). With an overall number of 8 causal factors captured under the PSC construct, five were revealed to be critical. They are the 1) the lack of meticulous project supervision (CC8) with an MI of 3.69, 2) lack of pro-active steps by funders to limit corruption on projects (CC13) scoring 3.60, 3) the distortion in information flow or symmetric information amongst project parties (CC 16) with a criticality index of 3.55, 4) the complexities involved in project and contractual structures (CC17), with an MI of 3.55 and 5) the lack of transparency in the selection criteria for tenders (CC22) with an MI of 3.50. The type and location of a project often influence the degree of its

vulnerability the corruption. Thus, complex projects and contractual systems in the developing context tend to be highly vulnerable to corruption as compared to small and simple projects and projects undertaken in a developed region with a more formidable structure to limit corruption (Wai 2006; Chan and Owusu 2017). The last and least evaluated construct among the five was Organizational-Specific Causes' (OSC) construct with an MI of 3.43. OSC refers to the causal factors of corrupt practices that stem from both the internal and external structures of either a public or private organization or institution. Simply put, they are negative organizational influences that instigate and breed corruption in an organizational setting (Owusu et al. 2017). Comparatively, this construct had the highest number of variables (i.e., 11 unique variables) and the highest number of critical variables (i.e., six variables). However, it was evaluated to be the least because of the lower scores obtained by the other five variables. From the topmost critical variable under this construct, the practice of inadequate sanctions (CC2) with an MI of 3.77 was evaluated by the respondents as the most critical followed by the lack of a positive industrial climate (CC 11) with an MI of 3.61 and the poor documentation of records (CC 12) scoring 3.61. The remaining three critical variables were suspending or delaying the payment of workers' salaries (CC15) scoring 3.56, over the competition in tendering process (CC20) scoring 3.50 and low wage level (CC23) also scoring 3.50.

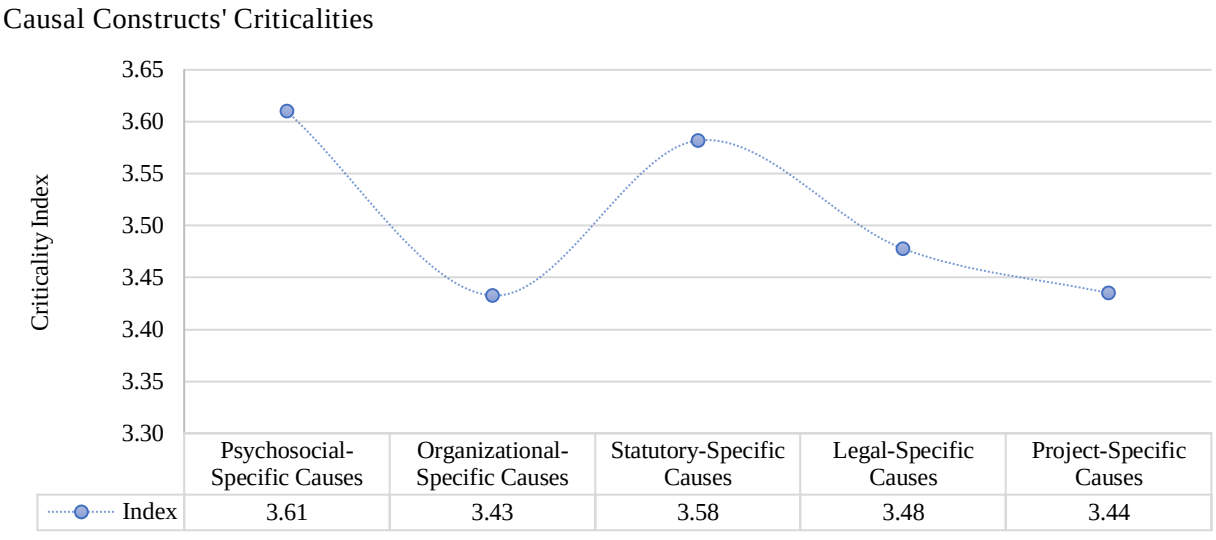


Figure 6.2: Graphical presentation of the criticalities of Corruption Causal Constructs

6.4 Procurement Irregularities[11]

This chapter aims to bridge the gap identified in the identification and examination of the risk indicators' construct, especially in the context of developing countries. Moreover, while the identified irregularities are identified to be critical in the developing context, their contribution to the incidence of corruption remains hypothetical. Therefore, aside bridging the identified gap by exploring the procurement irregularities in the context of the developing region, a further step is taken to test the hypothesis of their contribution to the incidence and proliferation of corruption within the procurement process. Thus, this chapter intends to explore the construct of corruption risk indicators also identified as irregularities by Tabish and Jha (2011) and corruption vulnerabilities by Le et al. (2014) in the context of developing countries using Ghana as the geographical point of focus. To realize the aim, three objectives are established. They are: 1) identify the corruption risk indicators or irregularities that are conjectured to render the infrastructure procurement process to corrupt practices; 2) examine the criticalities of the identified irregularities with their associated constructs and 3) test the hypothesis regarding the attribution of corruption incidence to the identified risk factors.

The identification of the criticality indexes of both individual variables is aimed at contributing to both theory and practice. Theoretically, as it has been highlighted earlier, this chapter does extend not only the theoretical base of corruption-related research regarding the subject matter but also bridges the research gap in this area in the developing region. That is, this section of the study is arguably the first empirical research to be conducted in this area. Moreover, it contributes to a deepened understanding of the subject matter of corruption in general and on the subtopic of corruption irregularities in particular.

Thus, it facilitates and adds to a deepened and more holistic understanding of the subject matter of corruption and the various constructs that contribute to the prevalence of corruption. Practically, this

[11] Owusu, E. K., Chan, A. P., Hosseini M. R., Nikmehr B., (2020). Assessing Procurement Irregularities in the Supply-Chain of Ghanaian Construction Projects: A Soft-Computing Approach. *Journal of Civil Engineering and Management.* Manuscript ID. SCEM-2019-0215.R1 *(In Press).*

chapter contained vital information relevant to industry practitioners, anti-corruption activists or advocates, researchers, and procurement board executives in the developing context (particularly in the context of Ghana). The information provided is not only aimed at drawing the attention of the mentioned parties to the procurement irregularities prevalent in the supply chain of procurement process but also to notify them about their degree of criticality regarding their probability and severity of the incidence and impact. Moreover, it aims at contributing to the development of a more holistic and stringent ACMs aimed at estimating not only the forms of corruption and the respective causal factors but also the potential irregularities possible of distorting the order of the procurement process. Lastly, this chapter is also intended to benefit researchers as it demonstrates that the application of soft computing techniques (i.e., fuzzy evaluation method) to examine the irregularities prevalent within the procurement process. It serves as a source of reference to continue this trend of corruption-related research in different fields.

Table 6.3: Factor Analysis of the variables (Irregularities)

No	Variables for Procurement Irregularities	Probability					Severity*					Overall		
		Mean	SD	Sig	N-V	Rank	Mean	SD	Sig	N-V	Rank	SI	Impact	N-V
1	Institution not following correctly the public procurement Acts in terms of obtaining minimum quotations, exceeding authorization threshold limits and unauthorized sole sourcing of suppliers	3.58	1.049	.000	0.58	8	3.66	1.007	.000	0.68	5	13.10	3.62*	0.61
2	Lack of adequate supervisory control over procurement transactions and management	3.39	1.014	.004	0.30	16	3.44	1.182	.005	0.30	12	11.66	3.41	0.25
3	Payments for uncompleted works	3.85	.973	.000	0.97	2	**3.84**	1.027	.000	1.00	1	14.78	3.84*	1.00
4	Non-application of sanctions	3.61	1.030	.000	0.62	7	3.48	1.184	.002	0.37	6	12.56	3.54*	0.47
5	Poor supervision of subordinate officers	3.56	1.182	.000	0.55	10	3.48	1.184	.002	0.37	6	12.39	3.52*	0.44
6	Disregard for public procurement Acts regulations	3.65	1.202	.000	0.68	5	3.48	1.225	.003	0.37	6	12.70	3.56*	0.51
7	Procurement not taken on ledger charge	3.63	1.134	.000	0.65	6	3.31	1.049	.025	0.07	16	12.02	3.47*	0.35
8	The procurement of goods and services by management without adequate resources to procurements committee of the various public institutions, which diverges from the provided regulations	3.47	1.170	.003	0.42	14	3.69	1.088	.000	0.74	3	12.80	3.58*	0.54
9	Variations to contract	3.45	.986	.001	0.39	15	3.39	1.136	.009	0.21	13	11.70	3.42	0.26
10	Outstanding Mobilization advances owing to non-observance of stipulated regulations	3.18	1.248	.267	0.00	18	3.37	1.059	.008	0.18	14	10.72	3.27	0.00
11	Fragmentary procurement	3.32	1.184	.036	0.20	17	3.48	1.004	.000	0.37	6	11.55	3.40	0.23
12	Little evidence of value for moneys spent	3.56	1.168	.000	0.55	10	**3.27**	1.162	.068	0.00	18	11.64	3.41	0.25
13	Sourcing of proforma invoices from the same supplier	3.87	1.079	.000	1.00	1	3.77	1.165	.000	0.88	2	14.59	3.82*	0.96
14	Overpayment of purchases	3.58	1.124	.000	0.58	8	3.35	1.202	.023	0.14	15	11.99	3.46*	0.33
15	Lack of proper co-ordination among key departments of the company and apparent internal control weaknesses reconciliation on Association	3.73	1.104	.000	0.80	3	3.68	1.037	.000	0.72	4	13.73	3.70*	0.75
16	Lack of consistent monitoring and review of procurement activities	3.66	1.055	.000	0.70	4	3.45	1.097	.002	0.32	11	12.63	3.55*	0.49
17	Lack of whole-of-government and corporate procurement planning for significant purchases	3.50	1.170	.001	0.46	13	3.48	1.141	.001	0.37	6	12.18	3.49*	0.39
18	Lack of audit trails or verification data	3.52	1.264	.002	0.49	12	3.31	1.139	.038	0.07	16	11.65	3.41	0.25

Note: SD = Standard Deviation; Sig = Significance; N-V = normalized value; SI = Significance Index

6.4.1 Developing the Constructs for the Risk Variables

Following the construct developed by the FA technique, the eighteen variables were captured under four constructs. They are administrative-specific irregularities, procedural irregularities, compliance irregularities,, and lastly, contract monitoring irregularities, which can also be regarded as probing-specific. The only studies that have been conducted to capture this construct either partially or fully were conducted in India and China by Tabish and Jha (2011) and Le et al. (2014), respectively. Interestingly, this construct stands to be unique, unlike the others in the sense that it is context-specific (Owusu et al. 2019). For instance, in the case of the forms, the definition of bribery act in a given context is somewhat similar if not the same in other contexts even though their criticalities may differ from one context to another. Similarly, personal greed as a cause of corruption is a generic causal factor that is bound to or can happen in any part of the world. However, corruption risk indicators are bound to happen in a more specific context as a result of the irregularities posed to the context. Therefore, during the exploration of this construct in the Indian procurement sector, the authors made use of the chief technical examiner's reports of India to extract the identified irregularities. The factors represented the contextual condition of India (Tabish and Jha 2011). Therefore, the development and enforcement of the needed strategic efforts to extirpate these irregularities would be context-specific since they are influenced by the identified context-specific irregularities.

In the second study (i.e., Le et al. 2014) conducted in China, the authors emphatically stated that the variables used in the study were adapted from the study of Tabish and Jha (2011). Justifications for adaption were attributed to shared socio-economic and demographic commonalities such as population and economic growth among others. Therefore, even though out of the 61 procurement irregularities identified by Tabish and Jha (2011), only 24 factors were considered in the study of Le et al. (2014) because they were the only variables that were common to both contexts. However, there were some commonalities in their respective constructs developed even though the two studies had uneven sets of variables (i.e., 61 in the case of India and 24 in the case of China), the identified variables were captured under five similar

constructs in both studies. The constructs were: transparency irregularities, professional standards, fairness, contract monitoring, and procedural irregularities.

This section of the study, therefore, followed a similar suit in naming the constructs since it is intended to contribute to previous studies as well as address the gaps identified in the earlier studies. Even though eighteen variables were captured under the study, they were categorized into four constructs by the FA technique as listed in the previous paragraphs. Therefore, while the procedural and contract monitoring constructs were identified in the previous studies, the other two constructs that evolved in this study were administrative and compliance irregularities. Therefore, even though the theoretical constructs in previous research influenced the labeling of the developed constructs, the second justification to the labeling of the constructs was that they were named by extracting the identical or common themes that existed among the variables (Owusu et al. 2019). The constructs developed in this chapter are discussed in the subsequent sections in their order of criticalities after the FSE results.

Table 6.4: Factor Analysis of the variables (Irregularities)

Code	Variable	C1	C2	C3	C4	Initial	Extraction
Administrative-specific							
ASI1	Lack of whole-of-government and corporate procurement planning for significant purchases	.771				1.000	.646
ASI2	Sourcing of proforma invoices from the same supplier	.760				1.000	.655
ASI3	Little evidence of value for money spent	.648				1.000	.637
ASI4	Lack of proper coordination among key departments of the company and apparent internal control weaknesses reconciliation on Association	.617				1.000	.473
ASI5	Non-application of sanctions	.548				1.000	.539
Procedural-Irregularities							
PII1	Fragmentary procurement		.797			1.000	.754
PII2	Procurement of goods and services by management without adequate resources to		.766			1.000	.625

	procurements committee of the various public institutions, which diverges from the provided regulations						
PII3	Procurement not taken on ledger charge		.624			1.000	.639
PII4	Variations to contract		.592			1.000	.482
Compliance Irregularities							
CII1	Institution not following correctly the public procurement Acts in terms of obtaining minimum quotations, exceeding authorization threshold limits and unauthorized sole sourcing of suppliers			.728		1.000	.582
CII2	Disregard for public procurement Acts regulations			.689		1.000	.563
CII3	Poor supervision of subordinate officers			.680		1.000	.597
CII4	Payments for uncompleted works			.482		1.000	.467
Contract monitoring Irregularities							
CMI1	Outstanding Mobilization advances owing to non-observance of stipulated regulations				.758	1.000	.780
CMI2	Lack of adequate supervisory control over procurement transactions and management				.689	1.000	.687
CMI3	Overpayment of purchases				.645	1.000	.509
CMI4	Lack of audit trails or verification data				.567	1.000	.608
CMI5	Lack of consistent monitoring and review of procurement activities				.515	1.000	.660
Eigenvalues (EV)		***5.603***	***2.145***	***1.729***	***1.425***		
Variance (VA)		***31.131***	***11.919***	***9.605***	***7.917***		
Cumulative Variance (%) (CV%)		***31.131***	***43.049***	***52.654***	***60.572***		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.							***0.714***
Bartlett's Test of Sphericity Approx. Chi-Square							***464.8***
df							***153***
Sig.							***.000***

6.4.1.1 Compliance irregularities

To comply means to adhere or conform or act in accordance with orders rules or other regulatory stipulations (Cambridge Dictionary 2018). The mention of compliance has evolved in several corruption-related studies, especially in the context of anti-corruption research. As the name implies, compliance in the context of anti-corruption studies connotes a responsive and proactive conformity to anti-corruption stipulations aimed at creating a corrupt-free environment (Owusu et al. 2018). Worthy et al. (2017) presented the forms of compliance by which public bodies, among others may comply with regulatory

stipulations. From the highest form to the least, they are concordance, full-compliance, partial-compliance, lesser-compliance, and non-compliance. The importance of this construct is attributed to the fact that the development and enforcement of anti-corruption measures need compliance mechanisms in place to ensure the effectiveness of the ACMs or ensure that the stipulated measures are being adhered to (Owusu et al. 2018).

However, this study identified one of the contextual irregularities in public procurement to be compliance risks. In effect, the construct reveals the criticality index of the potential loopholes that manifest in the form of compliance irregularities. At the construct level, the compliance irregularities construct was identified to be the most critical construct with an overall impact index of 3.64 with both of its probability of incidence and severity indicators respectively estimated to be 3.66 and 3.62, respectively. Four variables were captured under this construct. It was unsurprising to note that the non-compliance to the public procurement act coupled with limited or non-compliance with contractual stipulations regarding payment of non-executed works were noted as the top two critical irregularities as compared to the other two. While there are standardized procedures to facilitate the procurement process which is embedded in the public procurement act, not only did the A-G indicated this to be one of the most critical concerns in the public domain, the experts also highlighted this to be one of the most critical irregularities that have the potential to create room for corruption to flourish and also cause other financial, performance and standardization irregularities in a given public domain. The other critical concerns are the disregard for public procurement act and regulations and the payment for uncompleted works. Similar to the first to irregularities, the issue of this disregarding stipulated act is antonymous to compliance. Thus, in the first scenario, whereas public procurement officials may choose to follow some parts of the procurement policies (similar to partial compliance as defined by Worthy et al. 2017), the cause of disregard is directly synonymous to non-compliance. As such, the harm that this specific irregularity may lead to is likely to be greater than in the former case. Similar compliance-related irregularities were identified under the regulatory irregularities in the studies of Tabish and Jha (2011), indicating the criticality of this factor and the need to extirpate its

incidence, influence, and proliferation in the procurement process as well as other activities involved in public procurement.

6.4.1.2 Administrative Irregularities

Administrative irregularities can be defined in this context as the potential organizational risks that transpire due to weakened internal and external structures, depreciated organizational morality, professional and ethical standards within an organizational setting. This endangers the workflow, productivity, and overall institutional structures to two known and unknown corruption incidences (Owusu et al. 2017; Le et al. 2014). Analogous to the compliance irregularities construct, the administrative irregularities construct was identified to be one of the critical constructs made of 5 individual irregularities. Even though past studies have not captured the administrative irregularities as a construct, both the studies of Tabish and Jha (2011) as well as Le et al. (2014) identified professional standards irregularities as one of the five pressing constructs identified in the context of India and China respectively. However, some of the variables captured under the construct of professional standards irregularities are somewhat similar to those captured under administrative irregularities in this chapter. For instance, limited disclosure of money spent, unrealistic preparation of sound cost estimates, and unrealistic high rated or highly valued items that are not adequately verified or monitored existed under a common construct of all the three mentioned studies.

However, the remaining variables captured under this construct included sourcing or procuring of proforma invoices from the same supplier with a criticality impact of 3.82, and the lack of proper coordination among key departments and personnel within an organization with a criticality impact index of 3.70. The non-application of sanctions to unprincipled and undisciplined work ethics and the lack of whole governing body or management and corporate procurement planning for significant purchases also with a critical impact index of 3.49 were also captured. According to the A-G, these are critical administrative irregularities that have ensued within the administrative structures of the public procurement board for an appreciable period.

Moreover, the experts could not agree more to this concern. This justifies the criticality of the loopholes identified within the administrative structures of the public procurement system within the developing context and the need to extirpate these irregularities to limit the incidence of other unlikely events such as corruption among others. Lastly, on this construct, a recent study conducted by Owusu et al. (2018) on the measures established to extirpate corrupt practices in construction project management captured one of the constructs as administrative measures out of 6 constructs. This chapter, therefore, recommends that practical deduction can be made from the findings of Owusu et al. (2018) as it remains the most up-to-date review study of anti-corruption measures in this context. It would as well be needful for researchers and other anti-corruption advocates to draw strategic measures specifically skewed to limit or extirpate the incidence and impact of administrative irregularities in the public procurement system of developing countries.

6.4.1.3 Procedural Irregularities

Procedural irregularities represent one of the two constructs in this study captured by both studies of Tabish and Jha (2011) and Le et al. (2014). The word procedural simply means an established, usual, or an official way by which a task is executed (Cambridge Dictionary 2018). It is the adjectival form of the noun 'procedure' which can also mean method, plan, program, policy, or transaction. Any of these words aim at commencing and completing a specific task through an acceptable sequence. Thus, any form of risk posed to any task encapsulated in the process of the sequence of getting the specified work done can be termed as procedural irregularities. In the context of public procurement, the term lends itself to the distortion, risk, or threat posed against the established modus operandi of transacting an official or established procurement process. The explication of this term is needful to establish a common ground to discuss the variables captured under this construct. Tabish and Jha (2011), however, defined this term from the perspective of non-compliance, which has already been captured in our previous construct. While the concept of compliance can be captured under this construct, it must be emphasized that procedural irregularities can

manifest in different forms other than non-compliance. For instance, per the four variables captured under this construct in this study, the act of fragmentary procurement or variation to a contract may not necessarily be non-compliance to established procurement processes but can, however, pose a threat to the supply chain of the procurement process. Variations to contract take place as a result of different causal factors, including force majeure (Bing et al. 2004). This does not necessarily mean non-compliance to procedural stipulations.

However, if variations to a contract are not effectively handled, they may serve as a threat or susceptible grounds for corruption to flourish, such as inflation of the amount to cover the varied part of the given contract (Stansbury and Stansbury 2008). This is one of the rationales for emphasizing the definition of procedural irregularities. The mentioned procedural irregularities (i.e., fragmentary procurement and variations to contract) scored 3.40 and 3.42 respectively, which connote moderate criticalities. However, the severity impact of the fragmentary procurement and the probable impact of the variations to contract were identified to be critical by the experts. This implies the need for practical rectification measures to extirpate their respective concerns. However, apart from the two irregularities, the other two instead had appreciable levels of critical impact indexes. They include procurement not taking on ledger charge and the procurement of goods and services by management without adequate resources to the procurement committee of various public institutions, which diverges from the provided regulations. These two irregularities had their respective impact indexes to be 3.47 and 3.58, respectively, indicating the respective criticalities. The variables regarding the procurement of goods and services by management without adequate resources, which as well diverges from provided regulation, can as well be regarded as an administrative or non-compliance irregularity. This shows that even though some variables are specifically skewed towards a construct, they can as well be considered under other constructs indicating the relationship between the variables. There is, therefore, the need to pay critical attention to how the respective stages within the procurement process can be effectively structured to limit the incidence of these irregularities or the unlikely outcomes that are bound to happen should the irregularities happen.

6.4.1.4 Contract monitoring irregularities

The construct of contract monitoring irregularities was as well identified as the second out of the two constructs that have been captured in the previous studies mentioned (Tabish and Jha 2011; Le et al. 2014). Again, previous studies defined this construct to be the contractual laxities that ensue as a result of non-compliance to contractual stipulations or agreement. Therefore, it can be established that this one of the main limitations of the previous works on this subject matter. That is, attributing almost all the constructs to non-compliance. However, as established, this study postulates that not all the irregularities emerge or take place as a result of non-compliance. While non-compliance may be regarded as a direct causal factor contractual irregularities, it must be emphasized that other forms of irregularities other than non-compliance can instigate the emergence of new forms.

For instance, the topmost critical variable under this construct, which is the lack of continual stringent monitoring and the review and evaluation of procurement activities, may not be an issue of non-compliance as reported in the previous instance. However, as identified by the experts, this variable was revealed to have high criticality indexes for both the probability and severity indicators. This highlights the need to raise awareness on the development of stricter contract monitoring mechanisms to extirpate the identified irregularities. As mentioned, five irregularities were captured under this construct. However, regarding the remaining four, only one variable was identified to be critical, and that was the overpayment of purchases with an index of 3.46. The remaining three are I) the lack of inadequate trails or verification data, 2) lack of adequate supervisory control over procurement transactions and management, and 3) the outstanding mobilization advances incurred as a result of either limited or non-observance of stipulated regulations. These variables again can be attributed to administrative flaws, especially regarding the need to verify any given data on the specifications and any other information of purchases made and the need to ensure adequate supervisory control on procurement transactions.

This will enable early detection of both unidentified and unknown irregularities to facilitate the strategy formulation of effective measures to extirpate them. Again, per the stipulations presented by Worthy et al. (2017), the use of the term non-compliance as frequently used in past studies is highly debatable. The term non-compliance refers to zero adherence, according to Worthy et al. (2017). However, there are instances where the recorded irregularities may instigate or propagate as a result of partial compliance, lack of awareness, or absolute ignorance of certain demands or stipulations required of them. In such instances, the primary problem may not be attributed to non-compliance or adherence. Therefore, this section is intended to inform its audience about the correct use of the term non-adherence due to the relevance of the various forms of compliance (i.e., from noncompliance to concordance) and the measures required to check the specificity of the various levels of compliance.

Table 6.5: Overall Descriptors and Hypothesis Validation

No	**Risk Probability**			***Risk Severity***			***Overall***			
CT	***Index***	***LI***	***CE***	***Index***	***LI***	***CE***	***Impact***	***RK***	***LI***	***N-V***
ASI	3.66	High	0.26	3.55	High	0.25	$\sqrt{3.66 \times 3.55} = \mathbf{3.61}$	2	Critical	0.864*
PII	3.47	High	0.24	3.48	High	0.25	$\sqrt{3.47 \times 3.48} = \mathbf{3.48}$	3	Critical	0.273
CII	3.66	High	0.26	3.62	High	0.26	$\sqrt{3.66 \times 3.62} = \mathbf{3.64}$	1	Critical	1.000*
CMI	3.47	High	0.24	3.38	Neutral	0.24	$\sqrt{3.37 \times 3.38} = \mathbf{3.42}$	4	Neutral	0.000
Total	**14.26**		**1.00**	**14.03**		**1.00**				
OI	**3.57**			**3.51**			$\sqrt{\mathbf{3.57 \times 3.5}} = \mathbf{3.54}$		**Critical**	

LI = Linguistic; CE= Coefficient; RK = Rank; N-V = Normalized Value; OI = Overall Index

With the critical means set at 3.45 to 4.44 and the highly critical index set at 4.45 to 5.0, there were 12 out of 18 variables that were noted to be critical, and the remaining 6 noted as moderately critical. The most critical variable was identified to be payment for uncompleted works followed by the sourcing of proforma invoices from the same supplier. Four constructs emerged after running them under factor analysis. They included administrative irregularities, procedural irregularities, compliance irregularities, and lastly, contract monitoring irregularities. However, using the FSE technique to evaluate the criticalities of their

respective constructs, three were identified to be critical and 1 moderately critical. The most critical construct was identified to compliance irregularities construct, and the least was contract monitoring. With the overall criticality index at 3.54, the procurement irregularities were identified to be critical in the Ghanaian context.

Lastly, regarding the suppositions raised on variables' contribution to the incidence of corrupt practices, this study confirmed two constructs to be significantly critical towards rendering the entire procurement process to the incidence and proliferation of corrupt practices. Thus, despite the criticalities of the constructs, the normalized values upon which the validity of the four hypothesized statements were based revealed that the hypothesis regarding ASI and CII were accepted.

6.5 Assessment of the Impact of the Variables on the Procurement Process

This section examines the significant impacts of the individual variables on the procurement process. It must be emphasized that this section is primarily conducted to show the variables that affect the procurement process. Thus, aside from the information obtained regarding the susceptibility of the procurement activities, this section steps the previous results up by showing the real impact of the driving forces of corruption on the procurement process. It can, however, be postulated that any efforts taken towards the abatement of the susceptibility levels only addresses the issue of corruption at the vulnerability assessment level and not at the corruption extirpation level.

Moreover, inasmuch as the analysis conducted in this section represents a two-mode relational analysis, a higher emphasis is placed on the procurement process since the activities within the process are much more standardized as compared to the negative drivers of corruption, which are always evolving with new ways of corrupting the procurement process. **Fig. 6.2,** therefore, shows a conceptual framework of the relational impacts of the constructs on the procurement process. The expanded network analysis model is present next

right after the conceptual model (**Fig. 6.3**), showing the actual results of the significant relational model of the impacts of the variables on the activities on the activities of the procurement process.

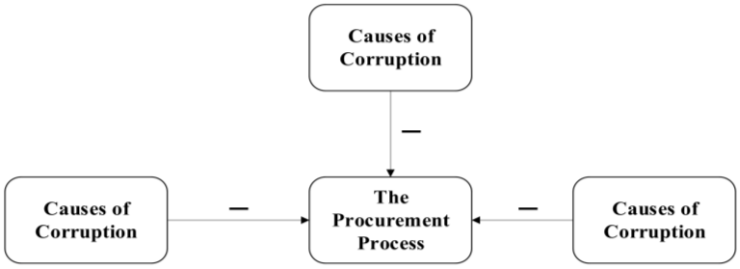


Figure 6.3: Conceptual illustration of the negative constructs of corruption on the procurement process

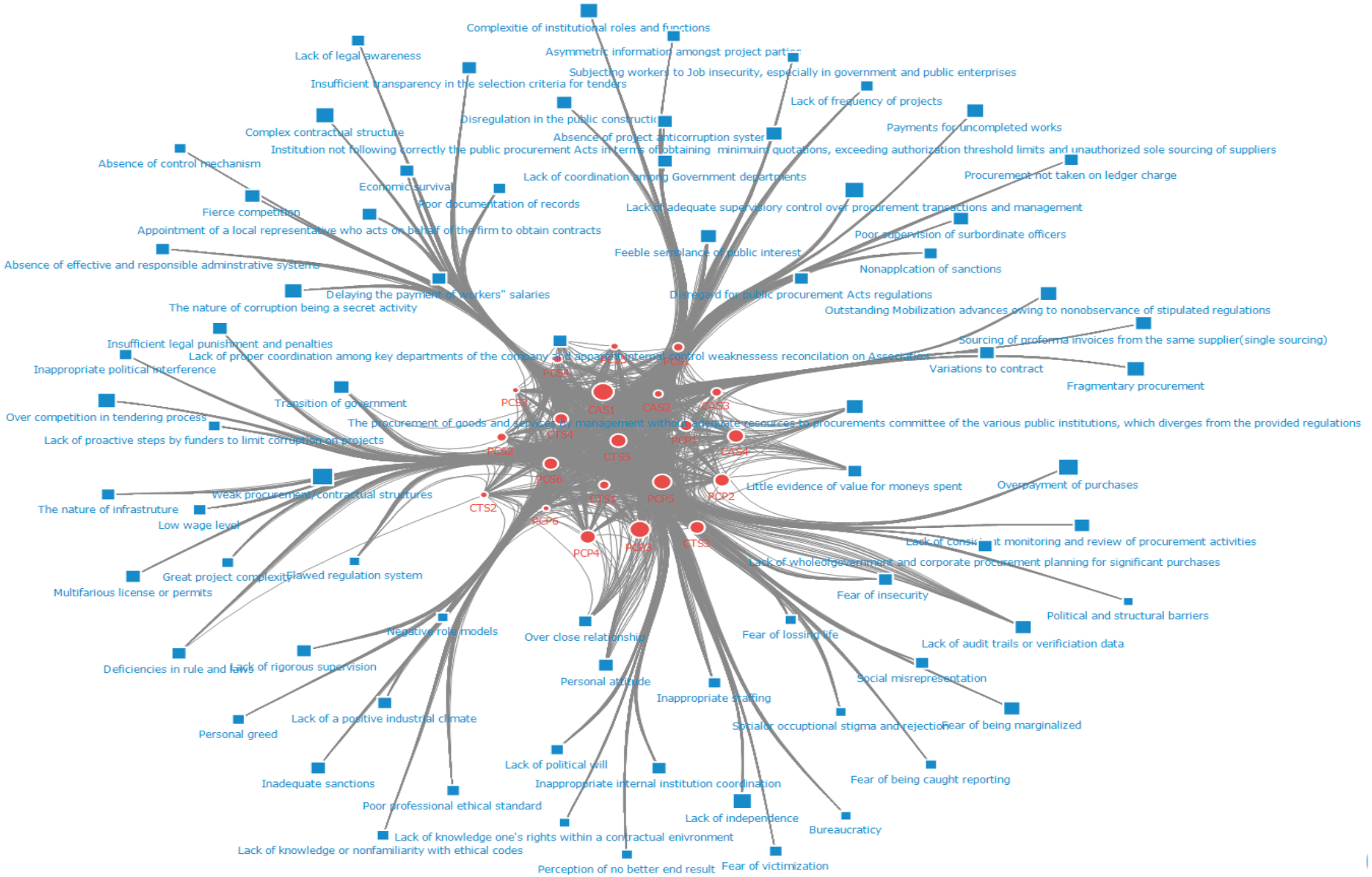
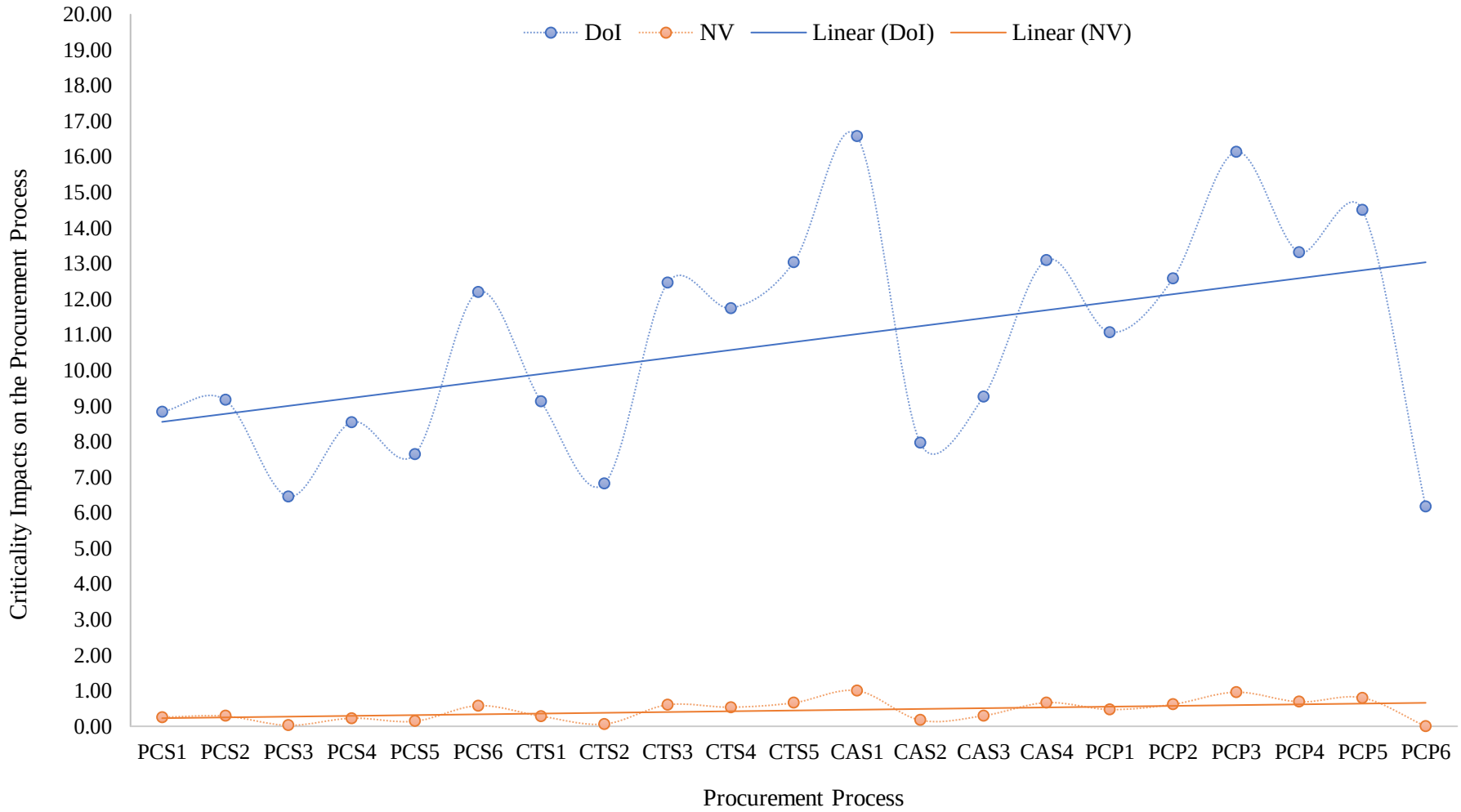


Figure 6.4: Network analysis of the negative constructs of corruption on the procurement process.



PP	PCS1	PCS2	PCS3	PCS4	PCS5	PCS6	CTS1	CTS2	CTS3	CTS4	CTS5	CAS1	CAS2	CAS3	CAS4	PCP1	PCP2	PCP3	PCP4	PCP5	PCP6
DoI	8.84	9.17	6.45	8.54	7.64	12.21	9.12	6.82	12.46	11.75	13.04	16.58	7.96	9.26	13.10	11.08	12.58	16.14	13.31	14.51	6.18
NV	0.26	0.29	0.03	0.23	0.14	0.58*	0.28	0.06	0.60*	0.54*	0.66*	1.00*	0.17	0.30	0.67*	0.47*	0.62*	0.96*	0.69*	0.80*	0.00

Figure 6.5: Criticality impact of the corruption constructs on the procurement process

Figure 6.3 presents an overarching overview of all the negative constructs explored in this study and their collective impact on the procurement process. In essence, the figure shows a two-mode relational analysis between the variables of all the negative constructs and the activities within the procurement process. However, the emphasis in this section is placed on the procurement process and the activities within the procurement process since that is the main area under investigation. Detailed explication regarding the individual constructs has been presented in other sections of the study. This section is therefore devoted to the dynamics or relational effects of the constructs of corruption on the procurement activities and stages. In general, eleven out of twenty-one stages were noted to be highly impacted by the constructs. Among the eleven impacted one activity was identified under the pre-contract stage, three out of five activities of the construct stage, two out of four at the contract administration stage, and five out of six activities at the post-contract stage.

Thus, none of the stages was exempted from the criticalities of the constructs of corruption. At the pre-contract stage where most of the preliminary works (building and contract works) such as defining the outlines and requirements of the proposed projects and obtaining necessary approvals among others were identified to be the stage with the least critical impact. Per the analysis, the only activity that was deified to be significantly impacted by the corruption constructs was PCS6 (that is, the receipt of leaders). While PCS4 (obtaining necessary approvals) and PCS5 (soliciting tenders) were noted as the most susceptible activities to corrupt practices, the network analysis revealed PCS6 (even though not as vulnerable as PCS4 and PCS5) as the most significant in terms of the constructs' criticalities at the pre-contract stage. It must be emphasized that the elimination or inclusion of any of the variables or associated construct of corruption may alter the overall results regarding the impact. However, the individual examinations were not conducted since the criticalities of all the variables had been previously examined.

Moving on to the next stage (i.e., the contact-stage), the three most impacted activities based on the normalized values were CTS3 (the selection of a contractor), CTS4 (awarding of contact) and CTS5 (the preparation and signing of contract). Moreover, similar to the findings on the vulnerability patterns of the activities, the evaluation of tenders as an activity was identified as one of the most vulnerable. Even though it may appear to

be somewhat surprising to note that the tender evaluation activity was not identified as one of the most impacted activity given its high susceptibility index, it must be emphasized that other constructs other than the causal factors of corruption may contribute to the low significance level of the CTS2 activity. Moreover, other than the vulnerable activities, the network analysis was performed to reveal other relevant activities that need to be checked to limit the incidence and proliferation of corrupt practices at the different stages of the procurement process. The contract stage (CTS) in most instances, is regarded as the most susceptible stage to corruption. The study findings confirmed this supposition even though the results "can be argued to be the views of the experts involved. Similar to the pre-contract stage, the development of anti-corruption measures and tools aimed at extirpating corrupt practices must consider how the vulnerability patterns of the vulnerable activities such as the tender evaluation stage and the contractor selection stage can be resolved. Another consideration can be attributed to how the overall impact can be checked at the contractor selection stage through to the award of the contract (Owusu et al. 2019).

Stage three (also known as the contract administration stage) also recorded similar results as compared to the previous stage. Two out of four activities were identified to be impacted by the collective force of all the variables captured under the negative constructs of corruption. The two activities are CAS1 (issuing of contract amendments) and CAS4 (administering progress payment). CAS4 was the only activity noted to be highly vulnerable to the incidence of corrupt practices (Owusu et al., 2019). The administration of progress payments is often identified to be clouded with the negative impacts of corruption due to the prevalence of some of the procurement irregularities such as the lack of adequate managerial or supervisory control over procurement transactions.

Moreover, other procurement irregularities such as unjustified variations in contracts and the lack of proper coordination among key departments responsible for procurement transactions are identified to contribute to the significant impacts of corruption on the procurement process and especially during contract amendment at progress payments' issuance stages. Other influences stemming from the corruption causal construct include weak contractual structures that often obscure the transparency of contractual payments, poor documentation of records, and often, the absence of control mechanisms. As a result, inasmuch as all the four activities captured under the CAS construct needs critical resolute measures in extirpating the influence and effects of corruption

on this stage, there is the need for greater attention on the conditions surrounding the process of contract amendments and the administration of progress payments as these variables were noted as the most impacted activities and the CAS4 noted as the most vulnerable activity to corruption in this stage.

Finally, a turn to the last stage of the procurement process reveals that not only are the activities ident) captured under this stage vulnerable to the criticality of corruption, but also the activities are recorded to be highly impacted by the negative constructs of corruption at this stage. Among the six activities captured and examined at this stage, five of the activities were identified to be crucial regarding their criticalities to the impacts of the construct of corruption. Thus, the activities noted were: 1) completing final audits, checking proofs of delivery (project deliveries), and returning of performance bond as closing out the contract. The only activity identified to be less critical regarding the impacts of the negative constructs is the confirmation of the accuracy and completeness of file documentations. Similar findings were noted under the vulnerability assessment stage. That is, aside from the first five activities identified to be vulnerable to corruption, the final activity within this stage (that is, PCP6) was the only activity noted to be less vulnerable to corrupt practices. Again, considering the criticalicality of this stage, there is the need to develop resolute measures aimed at neutralizing or reinforcing the activities against the likely occurrence of irregularities that renders the stage to the incidence of corruption. Thus, as examined, any framework developed to extirpate corruption at this stage should examine the correlational impacts of the causal factors of corruption, the barriers that hamper the effectiveness of anti-corruption measures at this stage, as well as the noted irregularities that obscure transparency in the procurement process. As such, future studies can examine how the variables captured under each of the constructs mentioned can impact the individual activities of the procurement process. This can be studied into great detail to establish to the individual activities' interactions with the various variables under each specific construct.

6.6 Chapter Summary

This chapter serves as an extension to the previous chapter by examining the criticalities of the negative constructs of corruption as it relates to the procurement process. Simply put, the constructs were empirically examined to identify how critical they are towards the various activities and stages of the procurement process.

Thus, they included the empirical assessment of the constructs of corruption, including the forms and the associated causal factors and risk indicators. With the most critical form identified to be bribery, collusive, and professional malfeasance acts, the notable cause factors were identified to be psychosocial and statutory-specific causal factors. Lastly, the payments made for uncompleted works, lack of proper coordination among key departments of an institution responsible for procurement works, and sourcing from the same supplies overtime via the medium of favoritism formed the leading indicators for the risk construct. In all cases, more than fifty percent of the variables captured under all the examined negative constructs were identified to be critical, signaling the widespread of corruption within the context under study.

CHAPTER 7 – EXAMINING THE EFFECTIVENESS OF ANTI-CORRUPTION MEASURES AND ASSOCIATED BARRIERS[12,13]

7.1 Introduction

Given that the endemic nature of corruption is often attributed to the causal factors as well as the contextual vulnerabilities, not much emphasis has been given to examining the proliferation of corruption in a given context in the light of the ineffectiveness of anti-corruption measures. As a result, inasmuch as continual efforts are expended by different scholars to ascertain the causal instigators of corruption, as well as the risk indicators, not many attempts, have been given to the influence of anti-corruption measures, especially in the case of developing countries. For instance, in the case of Ghana, there have been over 25 legal stipulations, including the enactments of laws against corruption, acts, decrees, legislation, and the constitution established enforced to check corruption since the country gained independence from its British in 1957 to date. However, corruption persists in the country, especially in most parts of the public sector (Osei-Tutu et al. 2010; TI, 2017). This reflects the situation of other developing countries that have countless anti-corruption stipulations but yet corrupt. Moreover, this stands to confirm, at least in the case of Ghana, that the enforcement of many anti-corruption measures does not necessarily correlate with or indicate low records of corruption.

As a result, there is a need to periodically conduct a critical assessment of the effectiveness and the performances of the enforced measures. This will help ascertain how effective or weak the existing anti-corruption measures are and determine whether there is a need for some level of reinforcement. Moreover, corruption-related studies in the context of developing countries and their exploration of the indicators of corruption in the public procurement sector, as well as the public construction-sector, have

[12] This chapter is fully or partially published in the following journal article: Owusu, E. K., & Chan, A. P. (2018). Barriers Affecting Effective Application of Anticorruption Measures in Infrastructure Projects: Disparities between Developed and Developing Countries. *ASCE Journal of Management in Engineering, 35*(1), 04018056.

[13] Owusu, E. K., Chan, A., & Hosseini, M. R. (2020). Impacts of anti-corruption barriers on the efficacy of anti-corruption measures in infrastructure projects: Implications for sustainable development. *Journal of Cleaner Production,* 119078.

not been that encouraging. Particularly in Ghana, apart from the periodic (annual) release of the Attorney General's report on public boards and departments, it is difficult to find and extract data from the public domain on the indicators related to corruption.

Against this backdrop, this chapter intends to investigate the potency of the measures developed and enforced to guide, check, and extirpate the incidence and proliferation of corrupt practices in infrastructure project procurement and management. Given the peculiarity of the context (i.e., project procurement and management), analogous and relevant literature published on the subject matter to date were consulted to understand the case of corruption in this context and the anti-corruption measures established to check corruption in the developing region. With other studies exploring some of the mentioned indicators, this chapter aims to investigate the existing anti-corruption measures in the context of public procurement and their potency or efficacy in limiting and expurgating the proliferation of corrupt practices during the procurement process of construction and engineering works. To realize this aim, three vital objectives are stipulated which are: 1) identify the existing anti-corruption measures established to mitigate corruption in infrastructure works; 2) examine the effectiveness of this measures in the context of public procurement process of construction and engineering works; 3) stipulate recommendations based on the findings. Evaluating the effectiveness of anti-corruption stipulations guiding a project can produce very vital information on the measures and the constructs that need further reinforcing mechanisms to make them recover the efficacy to become more resilient.

This chapter is highly relevant not only because of its theoretical contribution to the body of knowledge but also to practice. Theoretically, this study is arguably the first empirical assessment of ACMS established to guide, check, and extirpate corrupt practices in construction project management, especially in the developing context. Thus, it contributes originally to the body of corruption-related knowledge in infrastructure project procurement and management. Moreover, it adds to a deepened understanding of the subject matter of anti-corruption research, the development, enforcement, application, and the establishment of the mechanisms for their compliance. Regarding contribution to practice, the findings of this chapter are intended to inform project participants, policymakers, anti-

corruption institutions and researchers on the performance of the measures with their associated constructs and the need to reinforce the measures that are revealed to be weak or ineffective. Thus, rendering great support to these bodies to strategize the formulation of ACMs in a more focused direction skewed to a specific area in infrastructure procurement as management. Lastly, information on the apropos integration of the different constructs of the measures to yield high-end results can also be determined by examining the effectiveness and the relations of the ACMs and with other institutions /contexts and the processes which apply. As a foundational study, the information provided in this chapter can guide both scholars and institutional practitioners to develop more rigorous frameworks and assessment tools not only for evaluating the effectiveness of anti-corruption measures but also to determine the criticality of other constructs or indicators on the topics of corruption as highlighted previously. Analogous to other traditional manuscript outlines, the succeeding sections presents the systematic review of relevant literature, the extraction of the needed constructs and variables for an apropos questionnaire development (questionnaire development), the needed methods for the study (such as questionnaire formation, sampling techniques, presentation of data analysis and discussions and lastly, the limitations encountered and directions for future studies.

7.2 Anti-Corruption Estimation and Prediction Model Development

7.2.1 Index System Development

To commence, the six constructs identified in this section of the study are used to establish the foundation for the development of the evaluation index system (EIS) (Ameyaw and Chan 2015). Thus, the EIS is established by setting the constructs as the first-level index system (i.e., $u_{acm} = u_1, u_2, u_{3..}, u_m$) Where $u_1, u_2, u_{3..} u_m$ represents the individual constructs (i.e., sets that contain the individual ACM variables). Thus, they are probing, regulatory, reactive, compliance promotional and managerial measures and the variables within the constructs as the second level systems. Therefore, the set u_{acm} can be expressed as $u_{acm} = (u_{prm}, u_{rgm}, u_{mam}, u_{com}, u_{pbm}, u_{rem})$, and promotional construct is presented as $u_{prm} = (u_{prm1}, u_{prm2}, u_{prm3}, u_{prm4}, u_{prm5})$, since the construct is made up of five

measures. The other variables within other constructs are defined analogously. The index systems defined above forms the input variables for the fuzzy analysis. This is presented in **Table 7.1.**

Table 7.1: Anti-Corruption Variables

Code	Variables	MV	NV	SD	*Sig*	OR	CR	TM	WVC
	Regulatory Measures				$\boldsymbol{u_{rgm}}$			***8.82***	***0.111***
1	Comprehensive rules and regulations	2.98	0.25	1.094	u_{rgm1}	16	1		
2	Ethical code	2.97	0.23	1.201	u_{rgm2}	18	2		
3	Development of strong political and ethical will to enforce existing anti-corruption policies and laws.	2.87	0.00	1.194	u_{rgm3}	26	3		
	Managerial/Administrative Measures				$\boldsymbol{u_{mam}}$			***15.36***	***0.194***
4	Good leadership	3.31	1.00	1.168	u_{mam1}	1	1		
5	Professional associations	3.24	0.84	1.197	u_{mam2}	2	2		
6	Transparency mechanism	2.97	0.23	1.101	u_{mam3}	18	3		
7	Increase in accountability	2.94	0.16	1.279	u_{mam4}	21	4		
8	Financial disclosure/Disclosure	2.90	0.07	1.251	u_{mam5}	24	5		
	Compliance Measures				$\boldsymbol{u_{com}}$			***9.17***	***0.116***
9	Procedural compliance	3.19	0.73	1.171	u_{com1}	5	1		
10	Contractual compliance	3.00	0.30	1.187	u_{com2}	15	2		
11	Compliance to fairness and transparent procedures	2.98	0.25	1.248	u_{com3}	16	3		
	Promotional Measures				$\boldsymbol{u_{prm}}$			***18.12***	***0.229***
12	Information technology	3.11	0.55	1.368	u_{prm1}	6	1		
13	Raising awareness	3.08	0.48	1.205	u_{prm2}	9	2		
14	Enhance communication	3.03	0.36	1.241	u_{prm3}	11	3		
15	Education	3.03	0.36	1.187	u_{prm4}	11	3		
16	Training and development initiatives	2.97	0.23	1.305	u_{prm5}	18	5		
17	Access to information	2.90	0.07	1.197	u_{prm6}	24	6		

	Probing Measures				u_{pbm}			***15.76***	***0.199***
18	Contract monitoring	3.24	0.84	1.250	u_{pbm1}	2	1		
19	Whistle-blowing mechanism	3.24	0.84	1.250	u_{pbm2}	2	1		
20	Efficient reporting system (independent hotline)	3.11	0.55	1.203	u_{pbm3}	6	3		
21	Rigorous supervision among others	3.10	0.52	1.183	u_{pbm4}	8	4		
22	Rigorous technical auditing system	3.07	0.45	1.209	u_{pbm5}	10	5		
	Reactive Measures				u_{rem}			***11.91***	***0.150***
23	Dismissal from employment or other disciplinary action	3.03	0.36	1.379	u_{rem1}	11	1		
24	Harsh punishment or penalty	3.02	0.34	1.361	u_{rem2}	14	2		
25	Debarment/promoting fair debarment procedures	2.94	0.16	1.279	u_{rem3}	21	3		
26	Effective investigation, court proceedings, departmental disciplinary action	2.92	0.11	1.334	u_{rem4}	23	4		
								79.14	**1.000**

7.2.2 Determining the MF for variables and constructs of the ACM

The determination of both the variables and constructs membership functions are conducted by fuzzy mathematics (Ameyaw and Chan 2015). However, the MF of the variables are derived first by employing the grading alternatives used to evaluate the level of effectiveness during the questionnaire survey (i.e., *k=1,2,3,4,5; where k_1=very low, k_2=low, k_3=neutral, k_4= high, k_5= very high*). Therefore, the formula for computing the MF for a given variable is presented below;

$$MF_{u_{in}} = \frac{z_1 u_{in}}{} + \frac{z_2 u_{in}}{k_2} + \frac{z_3 u_{in}}{k_3} + \frac{z_4 u_{in}}{k_4} + \frac{z_5 u_{in}}{k_5} = \frac{z_1 u_{in}}{very\ low} + \frac{z_f u_{in}}{low} + \ldots + \frac{z_5 u_{in}}{very\ high} \qquad \textit{equation (1)}$$

Where u_{in} indicates the nth risk factor of a given construct i (i=u_{acm}= ($u_{prm}, u_{rgm}, u_{mam}, u_{com}, u_{pbm}, u_{rem}$). MF represents the membership function of a particular variable u_{in}; $Z_{g\,u_{in}}$ (*g=1,2,3,4,5)* indicates the percentage of the respondents involved in the expert survey who assigned a score g to

indicate the level of effectiveness to a given variable. Moreover, the terms $z_{1_{u_{in}}}/k_i$ connotes a relationship between $z_{1_{u_{in}}}$ and its respective grade scale k_i but not a fraction as it appears and the symbol '+' also represents a notation rather than an addition. Therefore, the MF of a given variable is presented as $MF_{u_{in}} = (z_{1_{u_{in}}} + z_{2_{u_{in}}} + z_{3_{u_{in}}} + z_{4_{u_{in}}} + z_{5_{u_{in}}})$ – equation (2). Using 'transparency mechanism as an example,

the $MF_{f_{in}} = \frac{0.10}{very\ low} + \frac{0.27}{low} + \frac{0.24}{moderate} + \frac{0.34}{high} + \frac{0.05}{very\ high}$ and presented as (0.10, 0.27, 0.24, 0.34, 0.05). The set of values in a defined MF range between (0 and 1) and the summation of all the values must equate 1. That is, $\sum_{g=1}^{5} Z_{g_{u_{in}}} = (0.10 + 0.27 + 0.24 + 0.34 + 0.05) = 1$. The MFs and the respective weightings for a particular ACM construct are processed to arrive at the MF for the particular construct. The MFs for the individual variables are presented in **Table 7.2,** and that of the constructs are computed in the next sections.

Table 7.2: Membership Functions (MFs) at ACM Variables and Constructs Levels

Code	Variables	Mean	Weightings	MF for Level 3	MF for Level 2
	Regulatory Measures				0.14, 0.21, 0.27, 0.31, 0.06
1	Comprehensive rules and regulations	2.98	0.338	0.13, 0.18, 0.31, 0.35, 0.03	
2	Ethical code	2.97	0.337	0.16, 0.18, 0.26, 0.34, 0.06	
3	Development of strong political and ethical will to enforce existing anti-corruption policies and laws.	2.87	0.325	0.13, 0.29, 0.26, 0.23, 0.10	
	Managerial/Administrative Measures				0.11, 0.22, 0.25, 0.29, 0.12
4	Good leadership	3.31	0.215	0.06, 0.21, 0.24, 0.32, 0.16	
5	Professional associations	3.24	0.211	0.08, 0.23, 0.21, 0.34, 0.15	
6	Transparency mechanism	2.97	0.193	0.10, 0.27, 0.24, 0.34, 0.05	
7	Increase in accountability	2.94	0.191	0.18, 0.19, 0.26, 0.26, 0.11	
8	Financial disclosure/Disclosure	2.90	0.189	0.16, 0.21, 0.32, 0.18, 0.13	
	Compliance Measures				0.11, 0.24, 0.24, 0.30, 0.11
9	Procedural compliance	3.19	0.348	0.06, 0.29, 0.15, 0.39, 0.11	
10	Contractual compliance	3.00	0.327	0.11, 0.26, 0.24, 0.29, 0.10	
11	Compliance to fairness and transparent procedures	2.98	0.325	0.16, 0.16, 0.34, 0.21, 0.13	
	Promotional Measures				0.13, 0.26, 0.21, 0.28, 0.13
12	Information technology	3.11	0.172	0.16, 0.21, 0.16, 0.29, 0.18	
13	Raising awareness	3.08	0.170	0.08, 0.29, 0.24, 0.24, 0.15	
14	Enhance communication	3 .03	0.167	0.13, 0.24, 0.21, 0.31, 0.11	
15	Education	3.03	0.167	0.11, 0.26, 0.19, 0.35, 0.08	
16	Training and development initiatives	2.97	0.164	0.16, 0.24, 0.19, 0.27, 0.13	
17	Access to information	2.90	0.160	0.11, 0.31, 0.26, 0.21, 0.11	
	Probing Measures				0.10, 0.23, 0.22, 0.32, 0.13
18	Contract monitoring	3.24	0.206	0.11, 0.18, 0.23, 0.32, 0.16	
19	Whistle-blowing mechanism	3.24	0.206	0.10, 0.23, 0.18, 0.34, 0.16	
20	Efficient reporting system (independent hotline)	3.11	0.197	0.10, 0.26, 0.19, 0.34, 0.11	
21	Rigorous supervision among others	3.10	0.197	0.10, 0.26, 0.19, 0.35, 0.10	
22	Rigorous technical auditing system	3.07	0.195	0.11, 0.21, 0.30, 0.25, 0.13	
	Reactive Measures				0.18, 0.21, 0.21, 0.25, 0.15
23	Dismissal from employment or other disciplinary action	3.03	0.254	0.19, 0.16, 0.24, 0.23, 0.18	
24	Harsh punishment or penalty	3.02	0.254	0.19, 0.18, 0.19, 0.29, 0.15	
25	Debarment/promoting fair debarment procedures	2.94	0.247	0.16, 0.24, 0.21, 0.27, 0.11	
26	Effective investigation, court proceedings, departmental disciplinary action	2.92	0.245	0.16, 0.27, 0.21, 0.19, 0.16	

7.2.3 Estimation of the weightings

The weighting of a particular ACM connotes the relative importance as expressed by the respondents involved in the expert survey. While it can be calculated from several methods such as normalized mean and the analytic hierarchy process, the normalized mean method was adopted to estimate the weightings for both the variables and the constructs (Lo 1999; Ameyaw and Chan 2015). The mean values obtained from the survey results are normalized to obtain the weighting function of both the individual variables and the construct. The formula used to estimate the weighting of function is given as

$$MF_{u_{in}} = \frac{M_i}{\sum_{i=1}^{5} M_i}, 0 < w_i < 1, and \ \sum_{i=1}^{5} w_i = 1 \qquad \text{equation (4)}$$

where w_i, represents the weighting function of a specific ACM variable or construct *i* and M_i indicates the mean value of a specific variable or construct. The estimated weighting functions of a given set (i.e., either variable or construct) is presented as w_i= $(w_1, w_2, w_3, w_4, w_5)$ - equation (5). Therefore, using good leadership as an example, the weighting is estimated as follows;

$$w_{\text{mam1}} = \frac{3.31}{3.31 + 3.24 + 2.97 + 2.94 + 2.90} = \frac{3.31}{15.36} = 0.215$$

Moreover, the weightings of the remaining constructs are computed as;

$$f_{rgm} = \frac{8.82}{8.82 + 15.36 + 9.17 + 18.12 + 15.76 + 11.91} = \frac{8.82}{79.14} = 0.111$$

$$f_{mam} = \frac{15.36}{8.82 + 15.36 + 9.17 + 18.12 + 15.76 + 11.91} = \frac{15.36}{79.14} = 0.194$$

$$f_{com} = \frac{9.17}{8.82 + 15.36 + 9.17 + 18.12 + 15.76 + 11.91} = \frac{9.17}{79.14} = 0.116$$

$$f_{prm} = \frac{18.12}{8.82 + 15.36 + 9.17 + 18.12 + 15.76 + 11.91} = \frac{18.12}{79.14} = 0.229$$

$$f_{pbm} = \frac{15.76}{8.82 + 15.36 + 9.17 + 18.12 + 15.76 + 11.91} = \frac{15.76}{79.14} = 0.199$$

$$f_{rem} = \frac{11.91}{8.82 + 15.36 + 9.17 + 18.12 + 15.76 + 11.91} = \frac{11.91}{79.14} = 0.150$$

w_i is therefore presented as = (0.111, 0.194, 0.116, 0.229, 0.199, 0.150). Moreover, the summation ofw_i, (i.e. 0.111, 0.194, 0.116, 0.229, 0.199, 0.150) =1. The weighting of all the variables and their respective constructs have been presented in **Table 7.2.**

7.2.4 Development of the Multi-Criteria and Multi-Level Fuzzy Model

Prior to the evaluation of the overall effectiveness index (EI) which is normally a single indicator to denote the level of effectiveness of the context under study, the effectiveness of the individual constructs is evaluated to determine the indexes for each construct. Therefore, to determine the effectiveness of a given construct, Ki is first established for every construct after the estimation of the membership functions for the variables within their respective constructs. Therefore, following equation (2), the membership functions of all the individual constructs are presented in a fuzzy matrix:

$$\mathrm{R_i} = \begin{vmatrix} MF_{u_{i1}} \\ MF_{u_{i2}} \\ MF_{u_{i3}} \\ \cdots \\ MF_{u_{in}} \end{vmatrix} = \begin{vmatrix} z_{1u_{i1}} & z_{2u_{i1}} & z_{3u_{i1}} & z_{4u_{i1}} & z_{5u_{i1}} \\ z_{2u_{i2}} & z_{1u_{i2}} & z_{1u_{i2}} & z_{1u_{i2}} & z_{1u_{i2}} \\ z_{3u_{i3}} & z_{1u_{i3}} & z_{1u_{i3}} & z_{1u_{in3}} & z_{1u_{i2}} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ z_{1u_{in}} & z_{2u_{in}} & z_{3u_{in}} & z_{4u_{in}} & z_{5u_{in}} \end{vmatrix}$$ – equation (6), elements are presented by $Z_{k u_{in}}$.

Therefore, Di, which represents the fuzzy evaluation matrix, is computed using the weighted function set of both the ACM variables and constructs, respectively. This formula is presented as follow;

$D_i = W_i \bullet R_i = (d_{in}, d, d_{in}, \ldots d_{in})$

$$D_i = (w_1, w_2, w_3, \dots w_n) \bullet \begin{vmatrix} z_{1u_{i1}} & z_{2u_{i1}} & z_{3u_{i1}} & z_{4u_{i1}} & z_{5u_{i1}} \\ z_{2u_{i2}} & z_{1u_{i2}} & z_{1u_{i2}} & z_{1u_{i2}} & z_{1u_{i2}} \\ z_{3u_{i3}} & z_{1u_{i3}} & z_{1u_{i3}} & z_{1u_{in3}} & z_{1u_{i2}} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ z_{1u_{in}} & z_{2u_{in}} & z_{3u_{in}} & z_{4u_{in}} & z_{5u_{in}} \end{vmatrix} = (d_{in}, d, d_{in}, \dots d_{in}).$$

Where d_{in} represents the grading scale degree of membership, k_i of a specific ACM construct *i;* the designation '●' connotes a composite operation in the fuzzy environment (Hsaio 1998; Ameyaw and Chan 2015). Therefore, using equation above, the compliance measures construct is computed as follows:

$$D_i = (0.348, 0.327, 0.325) \times \begin{vmatrix} 0.06 & 0.29 & 0.15 & 0.39 & 0.11 \\ 0.11 & 0.26 & 0.24 & 0.29 & 0.10 \\ 0.16 & 0.16 & 0.34 & 0.21 & 0.13 \end{vmatrix} = (0.11, 0.24, 0.24, 0.30, 0.11)$$

This is repeated for all the other constructs, and the results are presented in **Tables 7.2** and **7.3.** However, after the derivation of fuzzy evaluation matrix for each of the construct, the effectiveness index for each construct is computed using the formula $\sum_{i=1}^{5} D \times K^t,\ 1 \leq OEI \leq 5.$ – equation (7). Therefore, the effectiveness indexes of the constructs are computed as follows:

$$EI_{rgm} = [(0.14 \times 1) + (0.21 \times 2) + (0.27 \times 3) + (0.31 \times 4) + (0.06 \times 5)] = 2.92$$

$$EI_{mam} = [(0.11 \times 1) + (0.22 \times 2) + (0.25 \times 3) + (0.29 \times 4) + (0.12 \times 5)] = 3.08$$

$$EI_{com} = [(0.11 \times 1) + (0.24 \times 2) + (0.24 \times 3) + (0.30 \times 4) + (0.11 \times 5)] = 3.06$$

$$EI_{prm} = [(0.13 \times 1) + (0.26 \times 2) + (0.21 \times 3) + (0.28 \times 4) + (0.13 \times 5)] = 3.02$$

$$EI_{pbm} = [(0.10 \times 1) + (0.23 \times 2) + (0.22 \times 3) + (0.32 \times 4) + (0.13 \times 5)] = 3.15$$

$$EI_{rem} = [(0.18 \times 1) + (0.21 \times 2) + (0.21 \times 3) + (0.25 \times 4) + (0.15 \times 5)] = 2.98$$

The computed evaluation fuzzy matrixes, D_i *(i=1,2,3,4,5,6)* will then form the fuzzy matrix $\bar{R}$, for computing the overall effectiveness index of the measures.

$$\text{Therefore } \bar{R}_{(oei)} = \begin{vmatrix} MF_1 \\ MF_2 \\ MF_3 \\ MF_4 \\ MF_5 \\ MF_6 \end{vmatrix} = \begin{vmatrix} d_{11} & d_{12} & d_{13} & d_{14} & d_{15} \\ d_{21} & d_{22} & d_{23} & d_{24} & d_{25} \\ d_{31} & d_{32} & d_{33} & d_{34} & d_{35} \\ d_{41} & d_{42} & d_{43} & d_{44} & d_{45} \\ d_{51} & d_{52} & d_{53} & d_{54} & d_{55} \\ d_{61} & d_{62} & d_{63} & d_{65} & d_{65} \end{vmatrix},$$

Where i *= (1,2,3,4,5,6)* represents the individual constructs of the measures. Therefore, using equation 10, $\bar{R}$ is again normalized through the weighted function $\bar{W}_{(oei)} = (w'_1, w'_2, w'_3, \ldots w'_n)$, using the individual constructs to compute for the fuzzy evaluation matrix of the final stage as described in the previous section. This is therefore presented as;

$$\bar{D}_{(oei)} = \bar{W}_{(oei)} \bullet \bar{R}_{(oei)} = (w'_1, w'_2, w'_3, \ldots w'_n) \bullet \begin{vmatrix} d_{11} & d_{12} & d_{13} & d_{14} & d_{15} \\ d_{21} & d_{22} & d_{23} & d_{24} & d_{25} \\ d_{31} & d_{32} & d_{33} & d_{34} & d_{35} \\ d_{41} & d_{42} & d_{43} & d_{44} & d_{45} \\ d_{51} & d_{52} & d_{53} & d_{54} & d_{55} \\ d_{61} & d_{62} & d_{63} & d_{65} & d_{65} \end{vmatrix} = (D'_1, D'_2, D'_3, \ldots D'_n)$$

Where $'oei'$ represents the overall effectiveness index of the measures and $\bar{D}_{(oei)} = (D'_1, D'_2, D'_3, \ldots D'_n)$ connotes the fuzzy evaluation matrix for the overall effectiveness index (OEI) of the measures which can be quantified using the grading scores (k=1,2,3,4,5) using the formula below: $OEI_{acm} = \sum_{i=1}^{5} \bar{D} \times K^t = (D'_1, D'_2, D'_3, D'_4, D'_5) \times (1,2,3,4,5), 1 \leq OEI \leq 5,$

Where OEI_{acm} represents the index generated for the overall effectiveness index of anti-corruption measures in the developing countries. This stage is known as defuzzification (i.e., the fuzzy members are converted into crisp values/outputs), which facilitates decision making.

Table 7.3: Stages of the Procurement Process

No	Anticorruption Constructs	Weighting	MF for Level 2	MF for Level 1
1	Regulatory Measures	0.111	0.14, 0.21, 0.27, 0.31, 0.06	0.13, 0.23, 0.23, 0.29, 0.12
2	Administrative Measures	0.194	0.11, 0.22, 0.25, 0.29, 0.12	

3	Compliance Measures	0.116	0.11, 0.24, 0.24, 0.30, 0.11
4	Promotional Measures	0.229	0.13, 0.26, 0.21, 0.28, 0.13
5	Probing Measures	0.199	0.10, 0.23, 0.22, 0.32, 0.13
6	Reactive Measures	0.150	0.18, 0.21, 0.21, 0.25, 0.15

The fuzzy membership functions are thus defuzzified through the grading alternatives adopted (Sadiq and Rodriguez 2004; Ameyaw and Chan 2015). The actual calculations are presented below:

$$\bar{D}_{(oei)}=\bar{W}_{(oei)}\bullet\bar{R}_{(oei)}=\begin{vmatrix}0.111\\0.194\\0.116\\0.229\\0.199\\0.150\end{vmatrix}\times\begin{vmatrix}0.14 & 0.21 & 0.27 & 0.31 & 0.06\\0.11 & 0.22 & 0.25 & 0.29 & 0.12\\0.11 & 0.24 & 0.24 & 0.30 & 0.11\\0.13 & 0.26 & 0.21 & 0.28 & 0.13\\0.10 & 0.23 & 0.22 & 0.32 & 0.13\\0.18 & 0.21 & 0.21 & 0.25 & 0.15\end{vmatrix}=(0.13, 0.23, 0.23, 0.29, 0.12)$$

Therefore, using equation 10 above, the Overall Effectiveness Index of the ACM is given as:

$$\mathrm{ACM_{oei}}=[(0.13\times 1)+(0.23\times 2)+(0.23\times 3)+(0.29\times 4)+(0.12\times 5)]=3.05$$

7.2.5 Discussions

Generally, the overall effectiveness index of ACM in developing context is 3.05, which indicates that ACM in this context (especially in the case of Ghana) stands at the neutral level (i.e., moderately effective; not too bad nor too good). Moreover, the results may indicate why the diverse forms of corrupt acts are still prevalent in the developing context. However, it must be emphasized that the results indicate steady and gradual progress from ineffectiveness to neutral effectiveness of anti-corruption measures in the procurement and management of infrastructure projects. This is owed to the supposition that the strength of an institution or a country against the prevalence of corruption is directly correlated to the potency of stipulated anti-corruption measures in operation. In effect, the more potent the measures are, the less corrupt the context in question.

This section explored 26 anti-corruption measures derived from an extensive literature review. The measures were identified under six constructs, namely investigative measures, administrative measures, compliance measures, promotional measures, punitive or reactive measures, and lastly, regulatory measures (Owusu et al. 2019). The review explored the existing anti-corruption measures developed and enforced overtime to thwart and extirpate the proliferation of corrupt acts both in the short term and long term, respectively. The experts involved were asked to assess the effectiveness of the anti-corruption measures regarding their adoption in project procurement and management. Inasmuch as the Likert grading system ranging from 1-5, was adopted to indicate the level of effectiveness, none of the variables was approximately rated nor had a score of greater than 3.50 (which indicates effectiveness). Among all the 26 constructs, the highest-ranked variable obtained a mean index (MI) of 3.31 (which indicates moderately effective) and the lowest-ranked variable MI of 2.87 (also, moderately effective). The measures with their respective constructs are thus discussed in the succeeding section.

7.2.6 The development of the EI model for other Developing Regions

In developing the effectiveness index model (EIM), the index for all of the anti-corruption constructs were merged to establish a linear equation model. The technique is mostly adopted due to its ability or flexibility to allow for different ordinal grading scales (i.e., either 9, 7 or 5-point scale to be used in assessing the vulnerability index of procurement processes). Moreover, another advantageous justification for adopting the linear model approach is that it is clear, concise, logical, and easily understandable. It, therefore, allows practitioners and policymakers, anti-corruption institutions, and researchers to adopt or use it without difficulty.

However, prior to the development of the linear model for the evaluation of the overall EI for the anti-corruption measures stipulated to extirpate corrupt practices encountered in the procurement and management of projects in other developing regions, there was the need to normalize the individual EI of the ACM constructs in order to equate the summation of all the constructs to one (Osei-Kyei and Chan

2017). This can enable the evaluation or the estimation of any of the overall EI of either a proposed or existing project irrespective of the grading scale of linguistic terms adopted. **Table 7.4** presents the normalized values of the procurement constructs.

Table 7.4: Stages of the Procurement Process

Code	IP Stages	Weighting	Coefficients	Coefficient Symbols
RGM	Regulatory Measures	2.92	0.160	EI_{rgm}
MAM	Administrative Measures	3.08	0.169	EI_{mam}
COM	Compliance Measures	3.06	0.168	EI_{com}
PRM	Promotional Measures	3.02	0.166	EI_{prm}
PBM	Probing Measures	3.15	0.173	EI_{pbm}
REM	Reactive Measures	2.98	0.164	EI_{rem}
	Total	**18.21**	**1.000**	

Therefore, using the normalized values, the linear equation model of the estimation of the overall PVI for IP's in Ghana or other similar developing countries is presented below:

$$OEI = \mathrm{EI_{rgm}}[RGM] + \mathrm{EI_{mam}}[MAM] + \mathrm{EI_{com}}[COM] + \mathrm{EI_{prm}}[P\mathrm{RM}] + \mathrm{EI_{pbm}}[PBM] + \mathrm{EI_{rem}}[REM]$$

$$OEI = 0.160[RGM] + 0.169[MAM] + 0.168[COM] + 0.166[P\mathrm{RM}] + 0.173[PBM] + 0.164[REM]$$

- Equation 11

In equation 5, the coefficients assigned to each anti-corruption construct connotes their respective normalized values. According to the equation, probing measures turned out to be the construct with the highest coefficient value succeeded by administrative measures due to their respective high weightings obtained from the FSE technique, as presented in **Table 7.1.**

7.2.7 Performance of the Measures

Regulatory or statutory measures can be defined as legal stipulations (ranging from acts, decrees, regulations, etc.) enforced to avert the incidence and the proliferation of corrupt acts at the systemic or national level with its effects penetrating to public institutions and boards (Owusu et al. 2018; Tabish and Jha 2012). These measures are stipulated to create a clean environment towards a corrupt-free zone, conducive enough to limit indulgence (by self-driven, system motivated, or peer pressure) in corrupt acts. With an overall effectiveness index of 2.94, the variables captured under this construct (namely the establishment of comprehensive rules and regulations, ethical code, and the development of strong political and ethical will to enforce existing anti-corruption policies and laws obtained similar scores of 2.98, 2.97 and 2.87 respectively. Even though the regulatory measure's construct was the least ranked among the six constructs, the variable captured under this construct received relatively equal mean values obtained by the other variables.

It must be emphasized that the high number of statutory measures does not necessarily reflect or indicate less incidence of corruption. For instance, with more than over 25 statutory stipulations enforced to check the prevalence of corrupt acts in the case of Ghana, the effectiveness of regulatory measures in this context remain questionable. On the other hand, Hong Kong, which is known to have one comprehensive anti-corruption manual (i.e., the Prevention of Bribery Ordinance), and yet has been able to help check corruption to an appreciable level as compared to the previous decades. It is now regarded as one of the clean regions in the world regarding the incidence of corruption (Quah, 2016). This analogy supplements the notion that the number of statutory stipulations in a given context does not necessarily reflect how clean or corrupt that particular context is. A context may have very few stipulations and yet very clean. On the other hand, another state may have several laws stipulated to limit the proliferation of corrupt practices and yet corrupt, as presented in the case of Ghana. However, this supposition may need further empirical research to justify its validity.

This, therefore, prompts the need for compliance or adherence measures. Compliance measures are enforced to drive (either willingly or cogently) project parties to comply to laid down regulatory measures (Owusu et al. 2018). From **Table 7.1,** three variables captured under this construct are procedural compliance with an MI of 3.19, contractual compliance with an MI of 3.00, and lastly, the compliance to fairness and transparent procedures, also with an MI of 2.98. Thus, all three variables were also revealed to be moderately effective. Could there be a possible supposition that the level of attention given to compliance measures had a direct correlation with the performance or effectiveness of other constructs?

Owusu et al. (2018) attributed to the need for compliance measures as well as the deterrence from the notion that people often follow stipulated regulatory measures once enforced. The authors pointed out that until deliberate efforts are taken to inform and equip the parties to whom the stipulated measures affect, there is the tendency for corruption to prevail. Regarding the five facets of compliance measures, Worthy et al. (2017) instigated that whereas full compliance and concordance from the needed expectations from those whom the measures affect (project parties), the remaining three types of compliance (i.e., noncompliance, less compliance, and partial compliance) may have a negative implication or repercussions on the adoption of the measures. Therefore, after the development and enforcement of proactive or preventive ACMs, the next most important phase would be to establish compliance measures through which the stipulated measures can be fully applied to its best. Another resolute measure could be to integrate not only compliance measures in the tender documents or contractual stipulations binding a project but also indicate in the mentioned documents, the necessary reactive measures should they default or falter in any of the measures.

Administrative measures, unlike statutory measures, encompass the internal structures that regulate the behavior and actions of parties towards the prevention and extirpation of corrupt practices. Therefore, whereas statutory measures are considered to be of more external structures that affect a greater population, administrative measures are considered to be from within an organization, which vary from organization to organization and as a common trait, they derive their source or influence from statutory regulations. Per the

results, the administrative measures' construct obtained an index of 3.08, making it the second-highest ranked construct even though the measures captured under this construct were identified to be moderately effective. The variables encapsulated in this construct included good relationships, professional associations with an MI of 3.24, transparency mechanism with an MI of 2.97, and lastly, an increase in accountability as well as financial disclosure placing fourth and fifth with their respective mean values of 2.94 and 2.90. It is identified that the variables captured under this construct are all geared towards the creation of a transparent and accountable environment that fosters a corrupt-free environment.

Moving on to the promotional measures construct, the variables encapsulated in this construct are aimed at publishing and educating the informants (i.e., project parties) on the incidence, outcome, and resolute measures on corruption. With an overall construct MI of 3.02, the variables under this construct shared similar scores with the case of education, raising awareness, conducting training and development initiatives, access to information, information technology, and enhanced communication with their means ranging from 3.11 to 2.90. In other contexts, such as Hong Kong, this construct is identified to be a solid contributor to the extermination of corrupt actions. As such, there is a lone department responsible for dutifully executing the tasks related to promotional measures not only to keep the general public informed but also to develop context-driven training and initiative measures towards thwarting and extirpating corrupt practices in selected public departments (ICAC 2018). Thus, analogous to the compliance measures, the development of anti-corruption frameworks for a particular purpose without necessitating effective promotional measures to propagate the core elements or demands of the framework with the suitable means of adaptation and consequence, may propel the practices of corruption to persist.

Among all the constructs, probing measures received the highest construct EI of 3.15, indicating its importance and yet revealed to be moderately effective, just as in the cases of the other constructs. Probing measures refers to the proactive indicators established to facilitate and ensure effective auditing investigation processes (Owusu et al. 2018; Sichombo et al. 2009). Moreover, they can be considered as

corruption-preventive mechanisms established to monitor the periodic performance of projects to ensure that projects do not get susceptible to corrupt practices and thus create auxiliary surveillance to prohibit project parties from engaging in corrupt acts. They are therefore made up of variables including contract monitoring (with an MI of 3.24, being the highest-ranked variable under the investigative construct), whistleblowing mechanism, efficient reporting system both with MI's of 3.24 and 3.11 respectively.

The remaining variables captured under this construct include rigorous technical and auditing of project documents regarding finance, performance bonds, and standards, among others, as well as conducting rigorous supervision of project execution (with MI's of 3.07 and 3.10 respectively). Similar findings realized in the variables of the previous constructs are analogous to the case of this construct. The effectiveness of one has direction on another. Even though this construct is identified to be neutrally effective in the domain of the developing context, it is, however, known to be one of the strong anti-corruption mechanisms in the developed contexts like the HK. Moreover, even though every construct of the ACM plays a huge integral role in extinguishing the flames of corruption, ICAC (2018) opined that a greater share of the strength is derived from the effectiveness of the stipulated investigative measures. It is supported by the justification by Wai (2006) that it is only an effective investigative process that can lead to the discovery of an anticipated corrupt act. The offer further pointed out that the ICAC of HK expends over 70% of the institution's resources in the operations department (i.e., the department responsible for conducting investigations). However, in the case of developing countries, there would be a need for further studies to examine the impact of probing measures on the effectiveness of the other anti-corruption measures.

Similar to the case of probing or investigative measure, some scholars attribute the strength of most anti-corruption frameworks to the strength of its reactive measures (Bowen et al. 2007; Zou 2006). This is owed to the proposition that other proactive measures such as regulatory, administrative, and compliance measures may not be very stern as compared to reactive measures. Reactive measures can be described as

the threshold of every anti-corruption framework where culprits cannot cross but rather face the consequences of their actions. They are therefore regarded as control mechanisms stipulated to render justice, equity, or fairness as payback for the indulgence in a corrupt act. They consist of measures such as dismissing employers (project parties) from employment coupled with other disciplinary actions such as confiscating properties obtained by means of corruption, offering harsh punishment such as long-term or life imprisonment to offenders, barring identified culprits from taking part in future projects among others (Stansbury 2009; Sohail and Cavill 2008; de Jong 2009).

Again, all these measures obtained an MI ranging between 3.03 and 2.92 (also indicating a level of neutrally effective). Therefore, similar to other constructs, the reactive measures construct also obtained a construct EI of 2.98 obtaining the fifth position in terms of constructs ranking. As a common observation, there is the need to examine all the variables captured under all the constructs critically, and how they can be reinforced to obtain their full potency.

7.3 Barriers Inhibiting the Efficacy of Anti-corruption Measures

7.3.1 Introduction

Whereas extant literature attributes the proliferation of corrupt practices, especially within the domain of public project procurement and management, to the causal factors of corruption, succeeding works (e.g., Tabish and Jha 2011; Le et al. 2014) reported on the risk indicators associated with corruption in public projects. In effect, it was identified that corruption in public projects manifests as a result of causal factors as well as risk indicators. Typical examples include the complexity of projects and contractual structure, selecting unqualified contractors for megaprojects, and the distorted flow of information among project parties (Locatelli et al. 2014; Le et al. 2014; Owusu et al. 2014).

Thus, corruption research in this regard often highlights these two mainstreams as the problematic areas of concern, in tackling corruption (i.e., the causal factors of corrupt practices and the risk indicators of corruption). However, given that most anti-corruption measures were developed to tackle these two instigators of corruption, limited attention was and is still given to the exploration of the factors (barriers) that hamper the effectiveness of the enforced anti-corruption measures. Recent studies have emphasized the need to explore and overcome these barriers in specific contexts, as they do not only contribute to the ineffectiveness of anti-corruption measures but also the proliferation of corrupt practices at governmental, organizational, and project levels (Owusu and Chan, 2019). This research problem has not been adequately addressed in the extant project management-related scholarship. Particularly regarding public projects in developing countries such as Ghana. Additionally, there is very little knowledge of the quantitative impacts of various barriers types on the effectiveness of anti-corruption measures, owing to the lack of quantitative models that elucidate these impacts. In the ACMs application context, researchers, practitioners, and policymakers are interested not only in the barriers that are more critical but also which barriers are "significantly" correlated to the ACMs effectiveness. Such knowledge is useful to successful and effective development and application of ACMs in project management.

Against these backdrops, the specific this section aims to examine the question of why most anti-corruption measures, stipulated to guide the execution of corrupt-free projects in the developing countries, often fail. With projects exceeding their capped or budgeted limit excessively coupled with time overruns and substandard works due to corruption. How critical are the barriers against the anti-corruption measures?

In line with the established research problem, this study attempts to address the identified gaps in the existing project-management-related scholarship, contributing to the BoK by analyzing: (1) the impacts of the barriers (i.e., the probability and severity indexes); and (2) the degrees of influences of the barriers on the effectiveness of the ACMs. It must, however, be emphasized that the stated objectives are skewed towards project management in developing countries using Ghana as the representative scope, making it

arguably the first to examine the quantitative impacts of barriers on the effectiveness of ACMs in public project management. Thus, justifying its originality. This section in its entirety (that is, the constructs assessed, the hypothesis tested, and the model developed) is an original contribution to the scholarship of project management. It makes a significant contribution to the body of knowledge on corruption-related studies in project management by deepening understanding of the subject. Theoretically, since previous studies have not empirically addressed these issues from the perspective of project experts, the study's findings represent the first to reveal the correlational impact of the barriers on the effectiveness of anti-corruption measures.

Consequently, such findings also contribute to the existing body of knowledge (BoK) on corruption-related studies in project management. Cumulatively, the research provides anti-corruption institutions, policymakers, and industry practitioners that may assist in the development and implementation of more stringent anti-corruption tools and measures for extirpating the barriers that impede the effectiveness of ACMs in project management. The work also serves to provide a foundation for further empirical studies on the subject matter.

CODE	BARRIERS
BAC1	Political and structural barriers
BAC2	Fear of insecurity. Example, fear of losing Job
BAC3	Fear of losing life
BAC4	Social misrepresentation
BAC5	Fear of being marginalized
BAC6	Fear of being caught reporting
BAC7	Social or occupational stigma and rejection
BAC8	Bureaucratic process of reporting corrupt cases
BAC9	Lack of independence
BAC10	Fear of victimization
BAC11	Inappropriate internal institution coordination/inter agency relations
BAC12	Perception of no better end result, distrust in system
BAC13	Lack of political will, A lack of political will by government officials and statutory professional councils to fight corruption is seen as an exacerbating factor
BAC14	Lack of knowledge and understand of their rights within a contractual environment
BAC15	Inappropriate staffing
BAC16	Lack of knowledge or non-familiarity with ethical codes organizational codes of ethics
BAC17	Personal attitude, for example, lack of will to become involved in fighting corruption

ANTI-CORRUPTION MEASURES		
No	**CODE**	***Statutory Measures***
1	AC17	Enforcing comprehensive rules and regulations
2	AC20	Development and adherence to ethical code
3	AC26	Development of strong political and ethical will to enforce existing anti-corruption policies and laws
		Administrative Measures
4	AC1	Exemplary leadership
5	AC3	Enlisting in relevant and reputable professional associations
6	AC19	Establishing and reinforcing transparency mechanism
7	AC22	Ensuring increase in accountability
8	AC25	Financial disclosure
		Promotional Measures
9	AC6	Information technology
10	AC9	Raising awareness
11	AC12	Enhanced communication
12	AC13	Education
13	AC18	Training and development initiatives
14	AC24	Access to information
		Compliance Measures
15	AC5	Procedural compliance
16	AC15	Contractual compliance
17	AC16	Compliance to fairness and transparent procedures
		Probing Measures
18	AC2	Systematic monitoring of contracts
19	AC4	Developing and enforcing a stringent whistle-blowing mechanism
20	AC7	Efficient reporting system
21	AC8	Conducting frequent rigorous supervision
22	AC10	Enforcing a rigorous technical auditing system
		Reactive Measures
23	AC11	Administering disciplinary actions such as dismissal from employment
24	AC14	Imposing harsh punishment or penalty
25	AC21	Promoting and administering fair debarment procedures
26	AC23	Effective investigation, court proceedings, departmental disciplinary action

Figure 7.1: Individual variables and constructs of barriers and ACMs (Adapted from Owusu and Chan 2018 and Owusu et al. 2018).

7.3.2 Hypotheses Formulation

Before developing the hypotheses for this section of the study, it was expedient to relay the research framework. According to Darko et al. (2017), a research framework is needful for developing new knowledge. It can be based on either logic or theory or both (Simon and Goes 2011). Therefore, the research framework developed in this section is based on both theory and logic. Theoretically, the barriers that affect the effective application of ACMs are noted to contribute to the prevalence of corrupt practices (Owusu and Chan 2019). As there is no existing framework regarding the barriers construct in the literature, the empirical exploration of these constructs is identified to be in its infancy. However, inferences are taken from Le et al.'s (2014) study, which measured two negative constructs of corruption in the Chinese infrastructure sector. The constructs involved were the causes of corruption and the vulnerability to corrupt practices (Le et al. 2014). Therefore, it is theoretically identified in the literature that the correlation among the negative indicators and other constructs of corruption-related studies can be examined to ascertain its significant relationships and how these relationships can be extirpated. Thus, making both theoretical and practical contributions to the expurgation of corrupt practices in project procurement and management.

Regarding developing the hypotheses, this section focuses on two main corruption-related issues, namely, the barriers affecting the effectiveness of ACMs and the constructs of ACMs. The ineffectiveness of most ACMs has been the concern of many governments and private institutions (Owusu et al. 2017). Thus, this section partly addresses the concern by examining the identified ineffectiveness of the ACMs in light of the identified barriers. The term 'partly addresses' is emphasized because other corruption-related constructs other than the barriers may contribute to the incidence, influence, and proliferation of corrupt practices (Shan et al. 2017; Zhang et al. 2017). However, the measurement of corruption prevalence from the perspective of the ACMs' ineffectiveness, which is partly attributed to the identified barriers, has not been conducted yet. Therefore, as mentioned earlier, most of these attributions are directed to the causal instigators of corruption and risk indicators (Le et al. 2014). This section of the study is the first attempt to

measure the significance of the influences of the constructs captured under the barriers and ACMs. Comprehensive reviews have already been conducted on both constructs in previous studies (Owusu and Chan, 2019; Owusu et al., 2019). However, as explicated earlier, this section is specifically skewed towards the context of developing regions, and as a result, the indicators for both constructs were pilot tested to suit the context under study. Further explications on this point are presented in the methodology section. There are ten constructs to be tested (four barriers construct and six ACMs constructs). The four barriers are socio-political barriers, administrative barriers, psychosocial barriers, fear, and insecurity. The six ACMs are administrative, compliance, probing, promotional, reactive, and regulatory measures (Owusu et al. 2019).

Therefore, a total of 24 hypotheses are established from the four barriers and six ACMs (each barrier is mapped to the six ACMs). However, they are captured under four main themes:

1) Socio-political barriers have a significant negative influence on all the six ACMs' constructs;
2) Psychosocial barriers have a significant negative influence on all the six ACMs' constructs;
3) Fear and insecurity have a significant negative influence on all the six ACMs' constructs; and
4) Administrative barriers have a significant negative influence on all the six ACMs' constructs.

In order not to skew the hypothesis, there is a supposition that all the constructs captured under the barriers have significant negative influences on all the ACMs. The hypothetical framework is presented in **Fig. 7.2.** The results from the hypotheses testing do not only contribute to the theoretical exposition and contribution on the subject matter but also enlighten project parties, anti-corruption institutions and advocates, contract administrators, and policymakers about the barriers that significantly influence the effectiveness of ACMs in project procurement and management. Thus, they can contribute to the development and enforcement of ACMs that are effective to extirpate corrupt practices in project procurement and management.

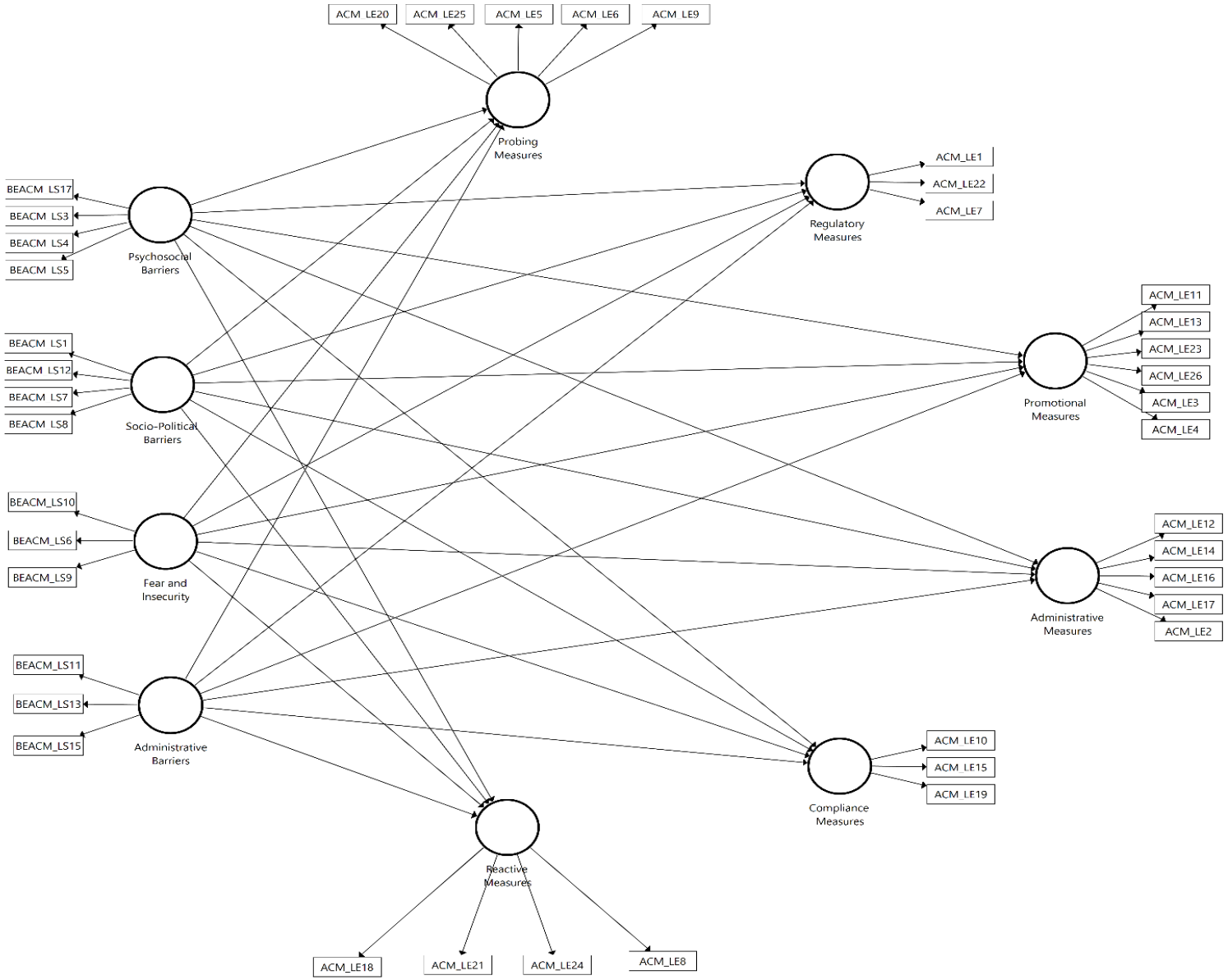


Figure 7.2: Hypothetical model of the study (expanded model).

Table 7.5: Descriptive and Impact Evaluation of Barriers to effective application of ACMs

Code	Variables	Probability					Severity					Overall		
		Mean	SD	Sig	N-V	Rank	Mean	SD	Sig	N-V	Rank	Sig	Impact	N-V
BAC1	Political and structural barriers	3.65*	1.073	.000	0.72	9	3.95*	1.015	.000	1.00	1	14.42	3.80*	0.88
BAC2	Fear of insecurity. Example, fear of losing Job	3.77*	1.108	.000	0.92	3	3.82*	.950	.000	0.81	3	14.40	3.79*	0.86
BAC3	Fear of losing life	3.44	1.196	.006	0.38	14	3.27	1.190	.074	0.00	17	11.25	3.35	0.00
BAC4	Social misrepresentation	3.39	1.150	.010	0.30	15	3.42	1.167	.006	0.22	14	11.59	3.40	0.10
BAC5	Fear of being marginalized	3.61*	1.150	.000	0.66	10	3.37	1.258	.024	0.15	15	12.17	3.49*	0.27
BAC6	Fear of being caught reporting	3.39	1.164	.011	0.30	15	3.37	1.218	.020	0.15	15	11.42	3.38	0.06
BAC7	Social or occupational stigma and rejection	3.48	.987	.000	0.44	13	3.61*	1.030	.000	0.50	9	12.56	3.54*	0.37
BAC8	Bureaucratic process of reporting corrupt cases	3.69*	1.080	.000	0.79	7	3.82*	1.109	.000	0.81	3	14.10	3.75*	0.78
BAC9	Lack of independence	3.52*	1.098	.000	0.51	12	3.56*	1.196	.000	0.43	10	12.53	3.54*	0.37
BAC10	Fear of victimization	3.81*	1.114	.000	0.98	2	3.56*	1.288	.001	0.43	10	13.56	3.68*	0.65
BAC11	Inappropriate internal institution coordination/inter agency relations	3.21	1.073	.129	0.00	17	3.52*	1.036	.000	0.37	13	11.30	3.36	0.02
BAC12	Perception of no better end result, distrust in system	3.74*	1.039	.000	0.87	4	3.63*	1.028	.000	0.53	5	13.58	3.68*	0.65
BAC13	Lack of political will, A lack of political will by government officials and statutory professional councils to fight corruption is seen as an exacerbating factor	3.73*	1.190	.000	0.85	5	3.63*	1.028	.000	0.53	5	13.54	3.68*	0.65
BAC14	Lack of knowledge and understand of their rights within a contractual environment, difficulty in providing concrete evidence	3.82*	.967	.000	1.00	1	3.90*	.953	.000	0.93	2	14.90	3.86*	1.00
BAC15	Inappropriate staffing	3.60*	1.108	.000	0.64	11	3.63*	1.120	.000	0.53	5	13.07	3.61*	0.51
BAC16	Lack of knowledge or non-familiarity with ethical codes organizational codes of ethics	3.69*	1.065	.000	0.79	7	3.56*	1.096	.000	0.43	10	13.14	3.62*	0.53
BAC17	Personal attitude, for example, lack of will to become involved in fighting corruption	3.73*	1.043	.000	0.85	5	3.63*	1.075	.000	0.53	5	13.54	3.68*	0.65

Note: SD represents standard deviation; Sig represents significance; N-V represents normalized value; '*' represents critical variables

Table 7.6: Factor Analysis of Barriers

Code	Variable	C1	C2	C3	C4	Initial	Extraction
Component1 Socio-Political Barriers (SPB)							
BAC1	Political and structural barriers such as instability	0.875				1.00	0.854
BAC12	Perception of no better result, distrust in the system	0.717				1.00	0.669
BAC7	Social or occupational stigma and rejection	0.568				1.00	0.649
BAC8	The bureaucratic process of reporting corrupt cases	0.503				1.00	0.506
Component2: Administrative Barriers (ADB)							
BAC13	Lack of political will by government officials and statutory professional councils to fight corruption		0.753			1.00	0.689
BAC11	Inappropriate internal institution coordination/inter agency relations		0.703			1.00	0.622
BAC15	Inappropriate staffing		0.655			1.00	0.474
BAC14	Lack of knowledge and understanding of their rights within a contractual environment, difficulty in providing concrete evidence		0.544			1.00	0.513
Component3: Psychosocial Barriers (PSB)							
BAC17	Personal attitude, for example, lack of will to become involved in fighting corruption			0.785		1.00	0.676
BAC4	Social misrepresentation			0.684		1.00	0.695
BAC3	Fear of losing life			0.562		1.00	0.601
BAC5	Fear of being marginalized			0.553		1.00	0.658
BAC16	Lack of knowledge or non-familiarity with ethical codes organizational codes of ethics			0.465		1.00	0.542
Component4: Fear and insecurity (FIB)							
BAC9	Lack of independence				0.843	1.00	0.791
BAC2	Fear of insecurity which includes fear of losing Job				0.665	1.00	0.695
BAC6	Fear of being caught reporting				0.588	1.00	0.629
BAC10	Fear of victimization				0.413	1.00	0.366
Eigenvalues (EV)		6.168	1.684	1.480	1.297		
Variance (VA)		36.282	9.907	8.705	7.627		
Cumulative Variance (%) (CV%)		36.282	46.188	54.893	62.520		
Construct Mean		3.69	3.62	3.50	3.60		
N-values		1.00	0.65	0.00	0.49		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.							.778
Bartlett's Test of Sphericity Approx. Chi-Square							478.022
df							136
Sig.							.000

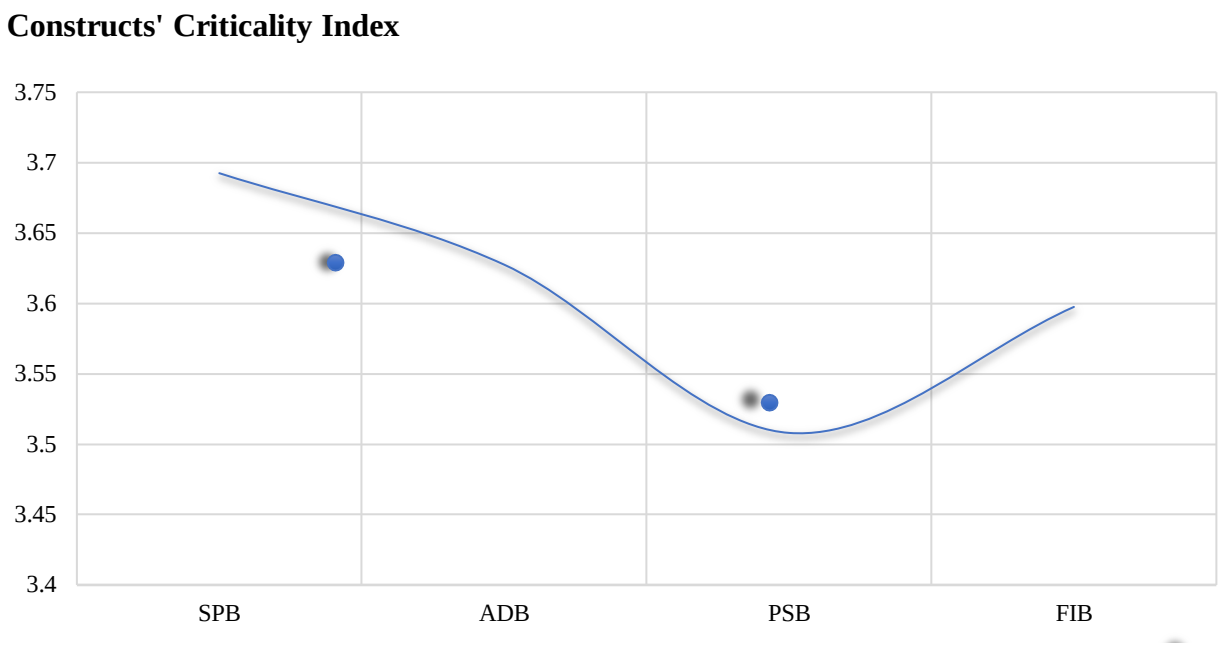


Figure 7.3: Criticality Impact Indexes of the Barriers' Constructs

7.3.3 Discussions

First, it must be emphasized that due to the copious amount of information gathered from the results, the discussion will be limited to the explications of the barriers constructs in conjunction with the PLS-SEM results. Thus, since the primary emphasis is on the barriers and all the constructs encapsulated under the barriers were found critical, the discussion will consider all the constructs from the topmost ranked barriers to the least. The analyses were conducted to identify not only the critical barriers and their associated constructs but also test the research hypotheses. While the individual barriers will be thoroughly explicated under their respective constructs, a summary of the results indicated high criticality indexes among all the barriers. Of the 17 barriers examined, 13 had high impact indexes, indicating that almost 80% of the identified barriers were critical in the context of project procurement and management processes. Moreover, the four constructs developed by FA were also found critical. To present thorough explications on the developed constructs and their respective variables, the adopted approaches with their respective results are presented in the next section.

7.3.4 The criticality of constructs and the variables

As stated earlier, FA was employed to establish the four respective constructs. The developed constructs were labeled based on the central thematic construction of the variables captured under them (Zhang et al. 2016; Owusu and Chan 2017). The four constructs are psychosocial barriers, social-political barriers, fear and insecurity, and administrative barriers. Moreover, even though the categorization of the ACMs was not conducted in this study, PLS-SEM was used to confirm the ACM constructs used in this study. The ACM constructs, therefore, included regulatory measures, administrative measures, promotional measures, compliance measures, probing measures, and reactive measures (Owusu et al. 2018). Since the detailed discussions on the ACMs have already been conducted in the study of Owusu et al. (2018), the present study rather discusses the significant influences of the barriers on the ACMs. However, the established hypothesis paths (i.e., the impacts of the barriers on the ACMs) are tested later in this study.

7.3.5 Measurement Models Evaluation

Table 7.7: Measurement Validity of the constructs

Latent Variables (Constructs)	Code	CA	rho_A	CR	AVE
Anti-Corruption Measures (ACMs)					
Administrative Measures	ADM	0.76	0.81	0.84	0.51
Compliance Measures	CPM	0.67	0.70	0.82	0.60
Probing Measures	PBM	0.79	0.79	0.85	0.54
Promotional Measures	PRM	0.83	0.85	0.87	0.54
Reactive Measures	REM	0.74	0.82	0.83	0.55
Regulatory Measures	RGM	0.64	0.75	0.84	0.73
Barriers to Against ACM Effectiveness					
Socio-Political Barriers	SPB	0.79	1.23	0.84	0.58
Administrative Barriers	ADB	0.74	0.79	0.85	0.65
Psychosocial Barriers	PSB	0.76	0.82	0.83	0.57
Fear and Insecurity	FIB	0.65	1.03	0.76	0.53

CA represents Cronbach's; AVE represents Alpha Average Variance Extracted; CR represents Composite Reliability

Table 7.8: Discriminant Validity of the constructs

Codes	ADB	ADM	CPM	FIB	PBM	PRM	PSB	REM	RGM	SPB
ADM	**0.803**									
ADM	0.104	**0.716**								
CPM	0.068	0.683	**0.774**							
FIB	0.277	0.157	0.205	**0.727**						
PBM	0.191	0.71	0.598	-0.015	**0.735**					
PRM	0.217	0.778	0.743	0.209	0.661	**0.731**				
PSB	0.525	0.17	0.173	0.542	0.097	0.259	**0.752**			
REM	0.205	0.663	0.592	0.109	0.791	0.732	0.326	**0.744**		
RGM	0.048	0.679	0.496	0.383	0.546	0.675	0.12	0.532	**0.853**	
SPB	0.461	-0.304	-0.206	0.463	-0.25	-0.152	0.525	-0.058	0.001	**0.763**

7.3.4.1 Socio-Political Construct (SPC)

This construct comprises of both social and political factors as defined by Merriam Webster dictionary (2018). It was developed using FA and encapsulated four critical variables. From the most critical to the least, the variables captured under this construct are political instability with an impact index of 3.80, the complex bureaucratic and social structures for reporting corrupt cases, with a high impact index of 3.75. Bowen et al. (2007) revealed the influence of politics on the problematic barriers in the South African construction industry. Similar identifications were found in the studies of Tabish and Jha (2011) that was conducted in India, as we as Shan et al. (2017) conducted in China. With the contexts noted above, it can be pointed that even though this barrier can hinder the effectiveness of ACMs in different countries from around the world, the study indicates that this political influence as a primary indicator is more critical in the developing context. It was, therefore, unsurprising to identify the obstructions posed by politics within the context of public-project procurement and management in the developing region to be the most critical variable under this construct. Politics affects corruption in many ways and has been identified as one of the powerful instigators of corruption in many parts of the world and also in public procurement and management of megaprojects (Soroide 2002; Owusu et al. 2018; Ameyaw et al. 2017). A direct implication is its influence on the effectiveness of the state's laws in general. This case may exemplify the macro effects of the negative implications of political structures. The result of such practices (political corruption) is that public institutions' departments and

boards suffer a fair share of the acts. At the micro-level, it advocates against any unhealthy decisions or practices from a political standpoint. This construct is better explained in the context of political corruption, where government officials and associates around them take advantage of their political position to exploit public office for illegal personal gains. Gale (2006) referred to this as government corruption. Thus, in effect, it may simply be regarded as government impediments and cuts across the entire public sector. Being one of the most complicated barriers because of the context involved, past studies have emphasized on some mitigation mechanisms, such as efficient checks and balances on the various arms of government. Moreover, given the complications attached to this barrier, political issues regarding corruption cannot be solved at the project level (Owusu et al. 2018). However, advocates may call for reinforcement actions on other arms of government to help check the faulty arm (Zou 2006; Owusu et al. 20019). For instance, as the barrier is instigated at the executive level, the judicial or legislative arm of government can be called upon to help check the case at hand.

Reporting a corrupt case can be complex, especially if the context within which the corrupt act to be reported consists of the extreme hierarchical order of power (Osei-Tut et al. 2010). It must, however, be emphasized that the phobia attached to reporting a corrupt case in the first instance put people off (Bowen et al. 2012). If one must also go through bureaucracy to get a case reported coupled with the immense fear of reporting, it is somewhat logical and safe not to get involved in such trauma at all. As a result, advocates claimed the need to provide accessible and safer procedures of reporting a suspected or identified corrupt case. Among these include the need to provide an efficient hotline for reporting corrupt cases (Powell 2006). This practical process has enabled different regions and institutions to get notified of any corrupt act. The remaining two are i) the lackadaisical attitude towards the adherence of anti-corruption stipulations emanating from the perception of no better results and ii) the lack of trust in the system (Ameyaw et al. 2017; Owusu and Chan 2019; Bowen et al. 2012). Lastly, the final variable under this contract is the occupational or social rejection and stigma by peers resulting from adherence to anti-corruption policies or not indulgence in a corporate, corrupt act (Krishnan 2009; Bowen 2007).

Surprisingly, among four significant relations identified as confirmatory justification to the ineffectiveness of ACMs, the socio-political construct was identified to have three significant negative influence on the ACM constructs. Specifically, of the six anti-corruption constructs that were observed, the socio-political construct was revealed to have strong negative influences on i) administrative measures [with the highest path coefficient of 0.656 indicating a strong impact and a t-value of 2.810 at significant level of 0.005], ii) compliance measures [also with the high path coefficient of 0.505 indicating a strong impact and a t-value of 2.308 at significant level of 0.021]; iii) probing measures [obtaining a path coefficient of 0.506 indicating a strong impact and a t-value of 1.832 at significant level of 0.067] and lastly on promotional measures [with the highest path coefficient of 0.517 indicating a strong impact and a t-value of 2.416 at significant level of 0.016]. Therefore, out of the six hypothetical relationships established to either confirm or disprove the negative socio-political influence on the six anti-corruption constructs, the socio-political construct confirmed its criticality as not only by having the highest impact index but also been identified as the main inhibiting force against four significant anti-corruption constructs. A part of the justification can be deduced from previous studies where some unethical or illegal political actions pose negative influences not only on anti-corruption policies but also the entire economic strength of the State.

7.3.4.2 Administrative barriers

Administrative barriers' construct was another concern after socio-political construct. It was, however, interesting to note that the criticality of the barriers' construct followed the hierarchical order of power. That is from the government level (where the parties are often government officials) to the institutional or administrative level. A total number of four variables were also captured under this construct, with an average criticality impact of 3.63. This, too, indicates that, analogous to the government barriers, the administrative barriers were also identified to be critical. The four variables under this construct are: inadequate possession of the needed knowledge and understanding of a contractual party in a contractual environment (Bowen et al. 2012; Stansbury 2009; Shan et al. 2015) and the difficulty in providing necessary solid evidence in the event of a corrupt incident (Owusu and Chan 2019; Bowen et al. 2012). Administratively, contracting parties are expected to know and understand every critical

stipulation presented in a contract document and any other document indicating the responsibilities of each party. Lacking knowledge on some of these critical contract requirements will not only leave the uninformed party ignorant about what is expected of him or her but also ignorant about the consequences of the actions of him/herself and other team members.

Consequently, in the event of any corrupt act (whether knowingly or unknowingly) the ignorant party may not be able to render any justification for his or her innocence. Thus, re-emphasizing on the common phrase "*ignorantia juris neminem excuseat*", meaning "ignorance of the law excuses no one" (Marriam-Webster 2018). It is, therefore, appropriate for all project team members to fully know and understand their rights and limitations in a contractual environment. Other critical variables under this construct are the lack of political will by officials to limit or fight corruption, and inappropriate staffing (Ameyaw et al. 2017; Bowen et al. 2012; Osei-Tutu et al. 2010). Similar to the first case, inappropriate staffing is noted as a primary contributor to knowledge gap creation (Owusu and Chan 2019). This happens when an employee is assigned a responsibility that he or she knows little or nothing about. Therefore, in the event of poor or non-performance, the employee is likely to be tempted to pay himself out just to maintain a clean name. Because of this, they become willing to contribute to corruption. Again, this may serve as one of the main contributory factors to the ineffectiveness of ACMs resulting from inappropriate staffing.

However, regarding the PLS-SEM model, the administrative barriers construct was identified to have a neutral, negative correlation with one of the most significant ACMs constructs: probing measures' construct obtaining a t-value of 1.778 at a significant level of 1.96 and a path co-efficient of 0.324 (signifying a neutral level of influence). Although most of the negative impacts were attributed to the criticality of socio-political constructs, administrative barriers' construct was identified to have a significant negative impact on one of the most promising anti-corruption constructs, probing measures. Probing measures have played a key role in dealing with corruption in Hong Kong (Wai, 2006). Wai (2006) indicated that the Department of Hong Kong's Independence Commission against Corruption (ICAC) unit that most funds are expended is the operations department, which is responsible for

conducting strategic and effective investigations. In short, the results indicate that the administrative barriers have a very strong and significant negative influence on the effectiveness of probing measures in Ghana. Thus, there is the need to strategically develop administrative measures aimed at extirpating their negative influence on probing measures as well as enhance the effectiveness of ACMs in general.

Table 7.9: Structural model Evaluation

No	Paths	(O)	(M)	(STDEV)	(|O/STDEV|)	P Values	Inference
	ADB → ADM	0.191	0.169	0.174	1.099	0.272	NS
	ADB → CPM	0.101	0.048	0.177	0.57	0.569	NS
	ADB → PBM	**0.324**	**0.282**	**0.182**	**1.778**	**0.075***	**Supported**
	ADB → PRM	0.247	0.221	0.182	1.354	0.176	NS
	ADB → REM	0.136	0.132	0.168	0.807	0.42	NS
	ADB → RGM	0.041	0.018	0.213	0.194	0.846	NS
	FIB → ADM	0.259	0.215	0.235	1.102	0.271	NS
	FIB → CPM	0.286	0.265	0.255	1.122	0.262	NS
	FIB → PBM	0.035	0.107	0.286	0.124	0.902	NS
	FIB → PRM	0.230	0.137	0.249	0.922	0.356	NS
	FIB → REM	0.008	0.082	0.22	0.034	0.973	NS
	FIB → RGM	**0.506**	**0.359**	**0.298**	**1.698**	**0.09***	**Supported**
	PSB → ADM	0.274	0.243	0.269	1.016	0.31	NS
	PSB → CPM	0.23	0.234	0.19	1.212	0.225	NS
	PSB → PBM	0.174	0.231	0.313	0.555	0.579	NS
	PSB → PRM	0.275	0.3	0.216	1.278	0.201	NS
	PSB → REM	**0.443**	**0.426**	**0.219**	**2.026**	**0.043****	**Supported**
	PSB → RGM	0.06	0.02	0.203	0.294	0.769	NS
	SPB → ADM	**0.656**	**0.547**	**0.233**	**2.810**	**0.005*****	**Supported**
	SPB → CPM	**0.505**	**0.413**	**0.219**	**2.308**	**0.021****	**Supported**
	SPB → PBM	**0.506**	**0.357**	**0.276**	**1.832**	**0.067***	**Supported**
	SPB → PRM	**0.517**	**0.440**	**0.214**	**2.416**	**0.016****	**Supported**
	SPB → REM	0.349	0.261	0.221	1.582	0.114	NS
	SPB → RGM	0.221	0.178	0.213	1.04	0.298	NS

Note: (O) = Original Sample; (M) = Sample Mean; (STDEV) = Standard Deviation; (|O/STDEV|) = T Statistics; No = Number of hypothetical relationships tested; NS represents not supported
***2.58 (at a significant level of 0.01); **1.96 (at a significant level of 0.05) and *1.65 (at a significant level of 0.1); NS means not supported

Table 7.9 presents the results of the bootstrapping. It demonstrates the various significant paths linking the barriers to the ACMs. Per the bootstrapping results, seven of the 24 paths were supported as their paths had t-values above 1.65, 1.96, or 2.58. This implies that the seven supported paths were statistically significant at 0.1, 0.05, and 0.01, respectively. These seven paths were: administrative barriers to probing measures, fear and insecurity to regulatory measures, psychosocial barriers to reactive measures, and lastly socio-political barriers to four different ACM constructs – administrative measures, compliance measures, probing measures, and promotional measures. Therefore, all the barriers were identified to have a significant impact on at least each of the ACM constructs.

However, the results revealed the criticality of the impact on probing measures, which were identified as the only ACM construct that had two significant constructs of barriers affecting its effectiveness. Path coefficients are identical to the weights of regression (Ozorhon and Oral 2017). The greater the path coefficient, the more influential an independent variable on a dependent variable (Aibinu and Al-Lawati 2010). Therefore, a path coefficient value within the range of 0.1 to 0.3 connotes a poor level of influence, 0.3 to 0.5 represents a neutral level of influence, and 0.5 to 1.0 illustrates a strong impact (Murari 2015). In this study, five of the seven significant paths had their coefficients to be above 0.50. These are SPB → ADM, SPB → CPM, SPB → PBM, SPB → PRM, FIB → RGM, indicating strong influence. The remaining two had their coefficients at the moderate levels (i.e., between 0.3 and 0.5). These are ADB → PBM, PSB → REM. Lastly, all the critical paths that the socio-political barriers had on the respective ACM constructs were identified to be within the range of 0.50 to 1.0, indicating that the construct was not only critical as a standalone construct but also has a strong negative influence on more than 70% of the ACMs. The final model indicating the influence of each construct and the significance of each path is presented in **Fig. 7.4.**

7.3.4.3 Fear and insecurity (FIB)

Fear is commonly defined as a feeling impelled by a perceived threat, whereas insecurity refers to the lack of confidence or uncertainty about oneself (Cambridge Dictionary 2018). The FIB construct was also developed by FA and ranked third with a criticality impact index of 3.60, which is critical. Four

variables were captured under this construct. From the most critical to the least, the variables include fear of insecurity, the fear of victimization, the lack of independence, and the fear of being caught reporting. It is unsurprising that the respondents revealed the fear of losing their job to be the topmost barrier under this construct. As highlighted in the PSB section, whereas some people prefer to keep mute to ensure that their lives are not threatened, others or the same people would as well be unwilling to reveal a corrupt case (whether as a witness or a suspected case) to secure their jobs (Owusu and Chan 2019). Moreover, in developing countries, securing a job is highly competitive, the willingness to go the extra mile to keep one's job free from threat is always worth taking even at the expense of reporting corrupt practices. This is where other barriers (such as the bureaucratic complexities that one must go through before reporting a corrupt case) also play a key role.

Thus, the impetus of relaying a corrupt case is lost in the end to allow corruption to go unreported. A similar phobia is attached to the other critical barriers under this construct, such as the fear of being victimized coupled with the lack of independent pose a significant threat of putting an end to corruption. Thus, the intended effectiveness of the stipulated ACMs is aborted due to these unresolved hindering variables. Moreover, among the hypothetical relationships drawn, the construct of fear and insecurity was also identified to have a strong influence on one of the ACMs' constructs, regulatory measures. Analogous to other critical and significant paths, the impact of FIB on RGM was identified to be one of the five most significant paths with a t-value of 1.698 at a significant level of 0.09 and a path co-efficient of 0.506 (signifying a strong level of influence).

Simply put, the measurement items under the construct of fear and insecurity are the contributory factors that hamper the effectiveness of ACMs from the perspective of limiting the effectiveness of stipulated regulatory measures. In the Owusu et al.'s (2017) study, regulatory measures are identified to be statutory measures enforced to enhance corrupt-free societies. It is an undeniable fact that most Ghanaians perceive the police service to be very corrupt (Pyman et al. 2012). Therefore, in most developing regions such as Ghana, the fear or the sense of insecurity attached to complying with regulatory measures such as reporting a corrupt case to the state's law enforcement agency is very high.

This is further justified by the corrupt behaviors of some of the law enforcement institutions, such as the police force. Thus, in effect, reporting a corrupt case to a law enforcement agent who is, in turn, corrupt can go to the extent of putting one's security or life at risk. Most especially if the suspected or the witnessed case concerns a powerful public official who often buys the trust and services of some of these law-enforcing agents. This is one of the relationships that transpire between the fear and security of a person against the effectiveness of stipulated ACMs from the perspective of regulatory measures. This, however, calls for the critical need of attention towards [regulatory] measures that are aimed at extirpating the negative forces of fear and insecurity attached to the effectiveness of enforced ACMs.

7.3.4.4 Psychosocial Barriers (PSB)

Finally, the PSB construct was identified to be the fourth-ranked construct among the others. As the name implies, the term lends itself to the interrelation of social attributes and the psychological make-up of a person and their impact on the ACMs stipulated to guide the procurement and management of public projects (Owusu and Chan 2019). Even though this term is mentioned in psychology and behavioral studies such as Greitzer (2013) and Heiser (2001), one of its first explication of this term in corruption-related research in this domain was offered by Owusu et al. (2017). The authors captured this construct as one of the causal constructs of corruption in public project management. Even though it can be regarded as the least ranked among the others, it was also revealed to be a critical construct just as the others with its criticality impact index as 3.50.

The most critical variable within this construct was identified to be the lack of knowledge or non-familiarity with ethical codes organizational codes of ethics. This variable had an overall impact index of 3.62, with its probability index to be 3.69 and its severity index as 3.56. Often, this barrier exists not only because parties within a specific context are ignorant about the code of ethics and professional standards that ensures the right thing to be done and behavior to be expected but also attributed to the perception of one's belief to be an ethical person. Persons within this category often have a firm belief in their ethical values rather than what has been stipulated by his/her organization (Owusu and Chan

2019). As such, the person may be susceptible to breach any of the obligations within the stipulated codes due to ignorance.

Moreover, if the person's actions object to regulations that are meant to extirpate corrupt practices, the person becomes either a liable party or contributor to corrupt practices rather than to prevent their incidence. A recent study by Owusu and Chan (2018) revealed this to be one of the critical barriers in the developing region. The remaining critical variables under this construct were personal attitude which includes the lack of will to become involved in fighting corruption with a criticality index impact of 3.68 and the fear of being marginalized with an index of 3.49 (Shan et al. 2015; Bowen et al. 2012; Bowen et al. 2007; Porter 1999). Lastly, even though the fear attached to losing one's life as well as being misrepresented were captured under this construct, the experts were of the view that they were not that critical as compared to the barriers captured under this construct. Their respective indexes were, therefore, 3.35 and 3.40, respectively. A recent report by TI (2018) reported on a witness of a corruption case who lost his life after expressing fears regarding his safety. It was as well reported that the son of the witness also lost his life three days after the death of his father. Cases like this often scare or puts people off in reporting a corrupt case to protect their lives.

Despite the fact of many pieces of evidence of people who have lost their lives as a result of reporting a corruption case or being a witness to corruption, this is one of the recent among the many cases reported during the period of conducting this study. The question is, how can someone ensure his/her safety after being a witness to corruption case or reporting a corrupt incident? There is, therefore, the need for this kind of study, especially in the context of developing regions. Regarding the PLS-SEM results, the PSB construct was identified to have one strong significant impact on reactive measures. That is, the measurement items within the psychosocial barriers were somewhat noted to have a driving influence on the ineffectiveness of the reactive measures construct. However, the impact of this construct on reactive measures was identified to be moderately significant, with a t-value of 2.026 at a significant level of 0.04 and a path coefficient of 0.443. Thus, there is the need to pay critical attention

to the measures that will not only help mitigate corruption but always address some of the criticalities and concerns associated with the PSB construct.

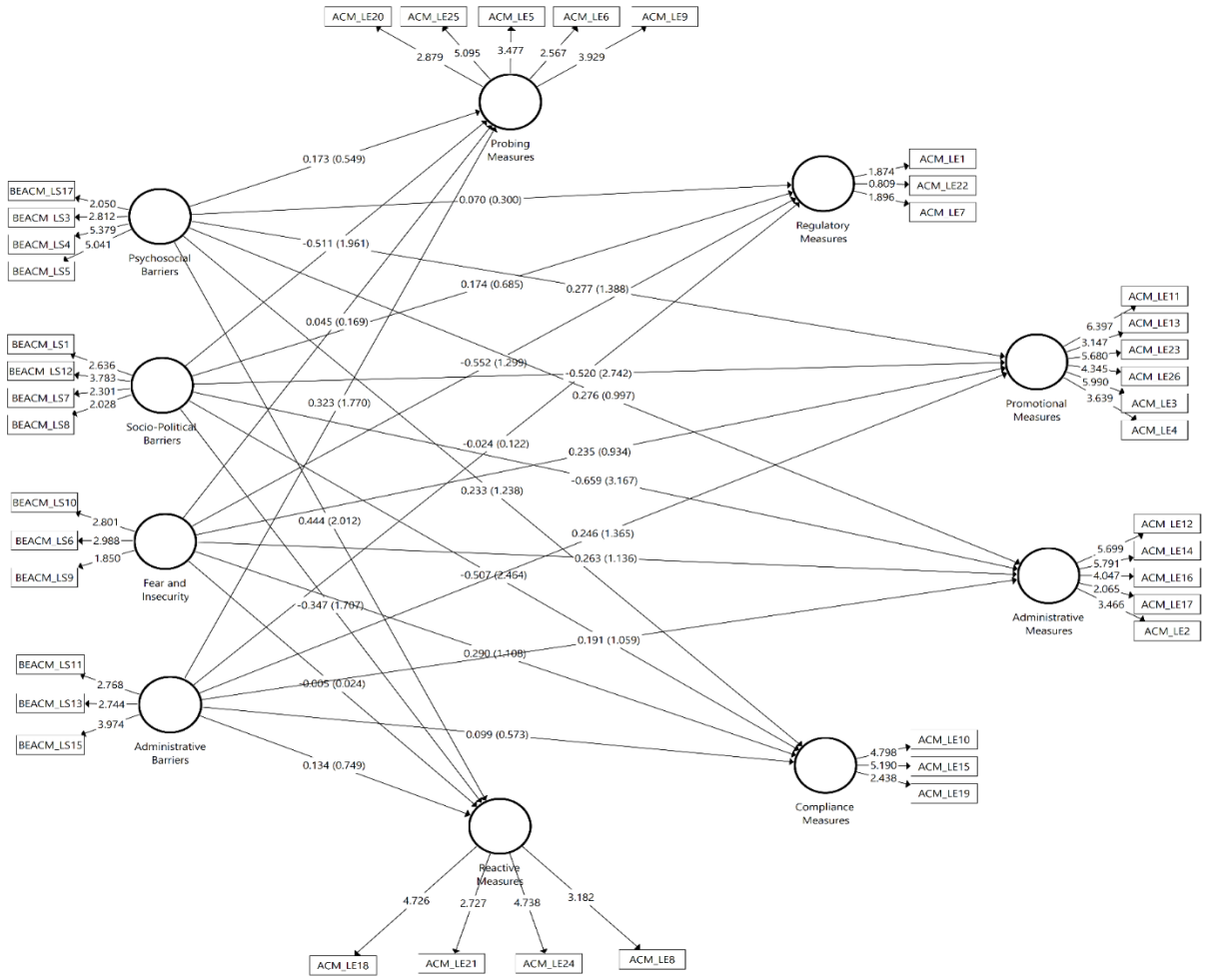


Figure 7.4: Structural Equation Model of the study (Expanded Model)

7.4 Chapter Summary

As one of the huge leaps in project management scholarship on the issue of corruption, this section of the study sought to explore the dynamic and significant impacts of the barriers that hinder the effectiveness of ACMs of the established ACMs constructs in public project procurement and management. With the noted ACMs identified as probing, regulatory, promotional, administrative, compliance, and reactive measures, this study first explored the criticality of the barriers identified to be psychosocial, socio-political, fear and insecurity, and administrative barriers and later, examined their influences on the established ACMs' constructs. The motivation behind this study section stems

from four primary concerns. They are: 1) the lack of attention given to the exploration of corruption concerns in project management scholarship; 2) the ineffectiveness of anti-corruption stipulations to check the prevalence of corrupt practices in public projects in developing countries; 3) limited explorative studies on the criticality of the ACM barriers in both project management-related literature and the developing context and 4) the significant relationship of the barriers on the ACM construct to facilitate decision making and future research.

However, to realize the aim, two key objectives were formulated together with twenty-four hypotheses. An expert survey was conducted with 62 professionals involved in the modus operandi of project procurement and management in the developing context. Different relevant techniques and tools ranging from descriptive statistics to FA and PLS-SEM were employed to conduct the pre-test and the main analysis of the data gathered. The results revealed the criticality of all the five constructs of barriers in the context of Ghana with the most critical construct identified to be socio-political barriers, and the most vital variable identified to be the lack of knowledge of a party within a contractual environment followed by political instabilities. With over 24 hypothetical relationships drawn to be tested, seven relationships were revealed to be significant. Thus, seven significant relationships revealed the impact and negative influence of the barriers on the ACM constructs. The socio-political construct, which was identified to be the most critical construct, was identified to have the highest negative influence on four different constructs, namely administrative, compliance, probing, and promotional measures. This indicates that in as much as all the barriers were identified to be critical, the most significant relationships that must be considered with a greater degree of attention as compared to the others are the significant negative relationships identified by the PLS results. Other significant paths include the administrative barriers on probing measures, fear and insecurity on regulatory measures, and lastly, psychosocial barriers on reactive measures.

CHAPTER 8 – GLOBAL PERSPECTIVES – COMPARATIVE ANALYSIS AND EXEMPLARY LESSONS

8.1 Introduction

Previous studies and reports emphasize the contextual disparities on corruption pervasiveness and control in the procurement process between countries in the developed and developing world (Ateljevic and Budak 2010; Osei Tutu et al. 2010; Agaba and Shipman 2007). However, empirical assessments of these presuppositions are lacking. Moreover, while there are varied suppositions on the procurement stages' susceptibilities to corruption, a holistic empirical evaluation of the stages regarding how susceptible they are to corruption is not available. Several suppositions revolve around the degrees of criticalities among the stages of the procurement process (Chartered Institute of Building (CIOB) 2013; Søreide 2002; Arewa and Farrell 2015). However, it is possible that different geographical contexts may indicate different levels of corruption criticality and the mitigation measures to expunge corrupt practices in the procurement process.

Given the polarization of presuppositions regarding the susceptibility and proliferation of corrupt practices in the procurement process and the lack of empirical justification, this section of the study attempts to answer the following question: how susceptible are the stages involved in the project procurement process to corruption and what are the critical forms prevalent at each stage in both developed and the developing countries? Furthermore, do all activities within the procurement process require an analogous amount of time and effort in extirpating their proliferation of corruption? In response to these questions, this section of the study presents empirical evidence of industry experts from both developed and developing countries concerning the susceptibility of the procurement stages to corruption and the prevalence of corruption forms in the procurement process. Concomitant objectives are to (1) explore the comparative disparities of corruption prevalence and anti-corruption effectiveness in developing and developed countries; (2) examine the degree of vulnerability of the IP stages and activities to corruption; and (3) determine the most prevalent corruption forms (CFs) at each

stage and within each activity of the procurement chain in both developed and developing countries. To answer the questions above, a three-stage iterative approach was adopted. First, a systematic literature review is conducted to identify the individual activities and stages of the procurement process. Second, a survey of international experts was later conducted using purposive sampling. Third, a number of descriptive tools were employed to analyze the data gathered. Findings reveal that the evaluation of tenders received, and the selection of a suitable contractor were identified as the most susceptible activities within the procurement process. However, the results of the two contexts were significantly dissimilar. Theoretically, since previous studies have not empirically addressed these issues from the perspective of international experts, the findings represent the first to address susceptibility levels of the different activities and stages of the procurement process and the criticality of the primary constructs of corrupt practices. Consequently, such work contributes to the existing body of knowledge (BoK) on corruption-related studies in project management. Moreover, this section of the study provides a richer understanding of the dynamism and behavior of corrupt practices in the supply chain of the procurement process. Cumulatively, the research offers anti-corruption institutions, policymakers, and industry practitioners with the knowledge that may assist in the development and implementation of more stringent anti-corruption tools and measures for reducing or expunging the identified CFs practices at specific stages of the procurement process. The work also serves to provide a foundation for further empirical studies on the subject matter.

8.2 Findings from experts survey

The results are presented in the order of the study's objectives, and the first section of the results presents the outcome for the first two objectives. To begin, the measurement items which encapsulates twenty-one distinct activities were captured under the four main constructs of the procurement process. The relative rank of each activity was obtained from the opinions of the participating experts involved (e.g., mean scores from the questionnaire survey). Even though an overview of the results is presented in **Tables 8.1 and 8.2**, the discussions primarily focus on the two contextual backgrounds of the experts (i.e., developed and developing countries). **Tables 8.1 and 8.2,** therefore, present a summary of the

susceptibility levels (presented by the mean indexes) of the stages together with significant disparities between stages or activities when comparing the two economies (shown by the Mann-Whitney U test results). Indeed, the results affirm the distinct and prevailing levels of corruption vulnerabilities between the two economies as substantiated by previous studies and world reports on corruption indexes.

Table 8.1: Descriptive Statistics and normality test of procurement activities

No	Procurement Process		Code	Mean	SD	p-value	CR	OR
1	Pre-Contract stage (PCS)	Define requirements	PCS1	2.48	1.11	0.000	4	17
2		Procurement process planning and strategy development	PCS2	2.45	1.06	0.000	5	18
3		Pre-tender survey	PCS3	2.66	1.25	0.000	3	12
4		Getting required approvals	PCS4	2.74	1.34	0.000	2	7
5		Tenders' solicitation	PCS5	2.94	1.50	0.004	1	3
6		Receipt of tenders	PCS6	2.30	1.39	0.000	6	21
7	Contract Stage (CTS)	Pre-tender meeting (to establish assessment criteria and plan as well as points to be allocated)	CTS1	2.66	1.27	0.000	4	12
8		Tender evaluation (evaluation to accept or decline tenders)	CTS2	3.03	1.45	0.011	2	2
9		Contractor selection	CTS3	3.14	1.47	0.051	1	1
10		Contract award/procure order	CTS4	2.91	1.43	0.001	3	4
11		Contract preparation and signing	CTS5	2.43	1.27	0.000	5	19
12	Contract administration stage (CAS)	Issuing contract revisions	CAS1	2.80	1.25	0.000	1	6
13		Progress monitoring	CAS2	2.72	1.34	0.000	3	8
14		Follow up delivery	CAS3	2.60	1.26	0.000	4	15
15		Administer interim or progress payments	CAS4	2.72	1.42	0.000	2	8
16	Post contract phase (PCP)	Filing of final action	PCP1	2.65	1.36	0.000	4	14
17		Issue final contract amendment	PCP2	2.68	1.34	0.000	3	11
18		Finalize financial audits	PCP3	2.69	1.44	0.000	2	10
19		Verify delivery/completed reports	PCP4	2.91	1.36	0.001	1	4
20		Returning performance bonds and contract close-out	PCP5	2.34	1.31	0.000	6	20
21		Confirm completeness and accuracy of file documentation	PCP6	2.59	1.33	0.000	5	16

Note: *indicates data with significant results of one-sample t-test ($p < 0.05$); Cronbach's Alpha = 0.962; Actual Chi-Square value = 65.440; Critical Chi-Square value = 31.410; df = 20; Asymp. Sig. of Kendall's W = 0.000; N=64; Construct Mean scores (MS): PSC=2.59; CTS= 2.83; CAS=2.71; PCP= 2.64.CR represents construct ranking: OR represents overall ranking.

Table 8.2: Stages of the Procurement Process

No	Procurement Process (TS[a])		Developing Region Respondents					Developed Region Respondents					Mann-Whitney U test			
			Mean	Std. Dev	Sig	CR	OR	Mean	SD	Sig.	CR	OR	U Sta	W*	Z	P value
1	Pre-contract	PCS1	2.6129	1.202	0.083	6	21	2.35	1.01	0.001	1	1	468.000	1063.000	-.803	0.422
2	stage	PCS2	2.7742	1.06	0.243	5	20	2.15	.99	0.000	3	5	352.000	947.000	-2.401	0.016[b]
3		PCS3	3.1935	1.14	0.351	3	15	2.18	1.17	0.000	2	4	284.000	879.000	-3.292	0.001[b]
4		PCS4	3.5806	1.15	0.009	2	6	1.97	1.14	0.000	5	8	184.500	779.500	-4.626	0.000[b]
5		PCS5	3.8710	1.09	0.000	1	4	2.09	1.31	0.000	4	6	180.000	775.000	-4.714	0.000[b]
6		PCS6	3.0333	1.38	0.895	4	18	1.65	1.04	0.000	6	13	219.000	814.000	-4.108	0.000[b]
7	Contract stage	CTS1	3.3226	1.17	0.134	4	11	2.09	1.04	0.000	2	6	230.000	825.000	-4.010	0.000[b]
8		CTS2	4.1290	0.81	0.000	2	2	2.03	1.14	0.000	3	7	96.000	691.000	-5.856	0.000[b]
9		CTS3	4.1935	0.87	0.000	1	1	2.18	1.22	0.000	1	4	114.000	709.000	-5.584	0.000[b]
10		CTS4	3.9677	0.91	0.000	3	3	1.94	1.10	0.000	4	9	106.500	701.500	-5.663	0.000[b]
11		CTS5	3.1613	1.16	0.444	5	16	1.77	0.99	0.000	5	11	192.000	787.000	-4.536	0.000[b]
12	Contract	CAS1	3.2903	1.10	0.153	2	12	2.35	1.23	0.004	1	1	305.000	900.000	-3.003	0.003[b]
13	administration	CAS2	3.2903	1.19	0.184	2	12	2.21	1.27	0.001	2	3	281.500	876.500	-3.321	0.001[b]
14	stage	CAS3	3.0968	1.22	0.662	4	17	2.15	1.13	0.000	3	5	305.000	900.000	-3.001	0.003[b]
15		CAS4	3.5484	1.18	0.015	1	8	1.97	1.19	0.000	4	8	195.500	790.500	-4.467	0.000[b]
16	Post contract	PCP1	3.3871	1.09	0.056	3	9	1.97	1.24	0.000	4	8	213.500	808.500	-4.243	0.000[b]
17	phase	PCP2	3.3871	1.09	0.056	3	9	2.03	1.22	0.000	2	7	224.000	819.000	-4.109	0.000[b]
18		PCP3	3.5806	1.18	0.010	2	7	1.88	1.15	0.000	5	10	177.000	772.000	-4.742	0.000[b]
19		PCP4	3.8065	1.01	0.000	1	5	2.09	1.08	0.000	1	6	147.500	742.500	-5.131	0.000[b]
20		PCP5	3.0323	1.35	0.895	6	19	1.71	0.91	0.000	6	12	234.000	829.000	-3.990	0.000[b]
21		PCP6	3.2581	1.26	0.265	5	14	1.97	1.09	0.000	3	8	239.500	834.500	-3.876	0.000[b]

Note: TS. Grouping variable: contextual groups (i.e., developed and developing countries)

b. Results indicating significant differences (data with significant results)

* represents data with significant results; Sta* represents U statistics; W* represents Wilcoxon W; SD represents standard deviation.

Constructs' MS for developing economies: PCS = 3.18; CTS = 3.76; CAS = 3.30; PCP =3.41

Constructs' MS for developed economies: PCS = 2.07; CTS = 2.00; CAS = 2.17; PCP = 1.94.

Given an almost uniform dispersion of both developed and developing countries, **Tables 8.1 and 8.2** demonstrate an overall susceptibility level of the procurement activities with their respective stages. Almost all the mean values fall within the range of neutral and are attributed to the balancing effects of both economies. The discussions are presented on a comparative basis of the representative contexts to highlight significant disparities between them (i.e., the developed and the developing countries). Although the respondents' overall opinion revealed relatively neutral levels of susceptibility in all the activities, stages that had the highest scores were the contract stage and the contract administration stage, which had MS of 2.83 and 2.71, respectively. However, cases between developed and developing countries were different, with several being regarded as more susceptible to corruption within developing countries (discussed later in the study).

The procurement activities in developing world countries are empirically identified to be more vulnerable than countries within the developed world. While this may be an undebatable argument, the MWU statistics also revealed high statistically significant differences between analogous stages of the two contexts. Out of the overall 21 activities, the MWU test results indicated that 20 stages (with the exceptions of PCS1) are statistically different regarding the levels of the activities' vulnerabilities to corrupt practices in the contexts of both economies. In all, the CTS construct of the developing countries was identified to be the most vulnerable stage of the procurement process, with a mean score of 3.76. This construct encapsulates activities such as the selection of a contractor (CTS3), which had the highest mean score and was regarded as the most vulnerable activity in the procurement process. Tender evaluation (review to approve or reject bids) (CTS2) and the award of contract or purchase order (CTS4) came second and third places in both CTS construct and the overall rank. Pre-tender meeting (CTS1) and the preparation came third in the CTS category, and 12th in the overall and signing of contract (CTS5) fifth the CTS construct and 16th in the overall scores. The significance of susceptibility magnitude of individual stage-by-stage comparisons of all the 21 activities, which demonstrate how momentous an individual procurement activity is over other activities within the same construct, is presented in the next section.

Moreover, per the actual mean results, there was at least one vulnerable activity in each stage. For instance, PCS4 under the pre-contract stage or CAS4 under the contract administration stage. However, the situation was dissimilar in the context of the developed countries as the mean indexes for all the various activities were identified to be moderately critical.

8.2.1 Stages-Comparative Results

To ascertain the order of distinctiveness between the two separate economies, the comparisons of the stages were made based on their constructs and economies. Tables 8.3 and 8.4 present the stage-by-stage comparisons of the constructs in the developed and developing countries, respectively.

Table 8.3: Developing Countries

Stage 1 – Pre -Contract stage							Stage 2 – Contract Stage					
Code	PCS5	PCS4	PCS3	PCS2	PCS1	PCS6		CTS3	CTS2	CTS4	CTS1	CTS5
PCS5	-	0.501	0.792	0.834	0.267	0.009[a]	CTS3	-	0.642	0.205	0.003[a]	0.001[a]
PCS4		-	0.312	0.266	0.079	0.042[a]	CTS2		-	0.426	0.005[a]	0.002[a]
PCS3			-	0.802	0.491	0.005[a]	CTS4			-	0.015	0.001[a]
PCS2				-	0.229	0.017[a]	CTS1				-	0.514
PCS1					-	0.006[a]	CTS5					-
PCS6						-	-					

Stage 3 – Contract administration stage					Stage 4 – Post contract phase						
Code	CAS4	CAS2	CAS1	CAS3	Code	PCP4	PCP3	PCP2	PCP1	PCP6	PCP5
CAS4	-	0.417	0.313	0.077	PCP4	-	0.253	0.086	0.099	0.029[a]	0.003[a]
CAS2		-	1.000	0.162	PCP3		-	0.288	0.248	0.161	0.062
CAS1			-	0.396	PCP2			-	1.000	0.593	0.266
CAS3				-	PCP1				-	0.551	0.220
					PCP6					-	0.453
					PCP5						-

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

Table 8.4: Developed Countries

Stage 1 – Pre -Contract stage							Stage 2 – Contract Stage					
Code	PCS1	PCS3	PCS2	PCS5	PCS4	PCS6	Code	CTS3	CTS1	CTS2	CTS4	CTS5
PCS1	-	0.491	0.229	0.267	0.079	0.006 [a]	CTS3	-	0.520	0.319	0.102	0.034 [a]
PCS3		-	0.802	0.792	0.312	0.005 [a]	CTS1		-	0.805	0.386	0.102
PCS2			-	0.834	0.266	0.017 [a]	CTS2			-	0.509	0.138
PCS5				-	0.501	0.009 [a]	CTS4				-	0.211
PCS4					-	0.042 [a]	CTS5					-
PCS6						-	-					

Stage 3 – Contract administration stage					Stage 4 – Post contract phase						
Code	CAS1	CAS2	CAS3	CAS4	Code	PCP4	PCP2	PCP6	PCP1	PCP3	PCP5
CAS1	-	0.371	0.197	0.011 [a]	PCP4	-	0.527	0.380	0.458	0.131	0.006 [a]
CAS2		-	0.720	0.142	PCP2		-	0.763	1.000	0.388	0.039 [a]
CAS3			-	0.347	PCP6			-	1.000	0.477	0.021 [a]
CAS4				-	PCP1				-	0.405	0.084
					PCP3					-	0.096
					PCP5						-

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

Tables 8.3 and 8.4 present the Wilcoxon's signed-rank (WSR) test result at p-value < .05. This which in turn specify the significance of the degree or extent of the stage-by-stage susceptibility to corrupt practices. This test is performed to shed light on the significance of how a stage is more vulnerable to the acts of corruption than another stage. The mean results reveal either an activity or a stage to be critical than the other, and the Wilcoxon is only introduced to inform how significant the magnitude or the degree of criticalities between two variables or activities being compared.

Therefore, even though an activity within any of the stages of the procurement process can be regarded as highly vulnerable than another per their respective mean indexes, the outcome does not necessarily show that the variation between the activities being compared is significant. This is because an activity with a higher MS when compared to another, may not necessarily have a significant degree of difference when compared with another variable with a relatively lower mean index. Therefore, the higher the rate or value of significance that a variable possesses when compared with others, the more relevant (or in this case 'critical') the magnitude of the variable in its mean rank against the others.

In both contexts, the highly critical activities in their respective stages have been indicated based upon their corresponding alpha values. Only three activities were statistically rated as being significant (critical) than at least two other activities within their respective constructs (stages) for developing countries, namely: CTS3 (contractor selection); CTS2 (tender evaluation); and PCP4 (checking for proof of delivery). For instance, at the post-contract stage, PCP4 was the only activity that had a higher significance level than at least two other activities (i.e., PCP6 and PCP5). Other significant activities' ratings included all the activities at the pre-contract stage except for 'receipt of tenders' (PCS6). Moreover, there were no statistically significant activities at the contract administration stage (CAS). Lastly, CTS2, CTS3, and CTS 4 were identified to be significant activities at the contract stage.

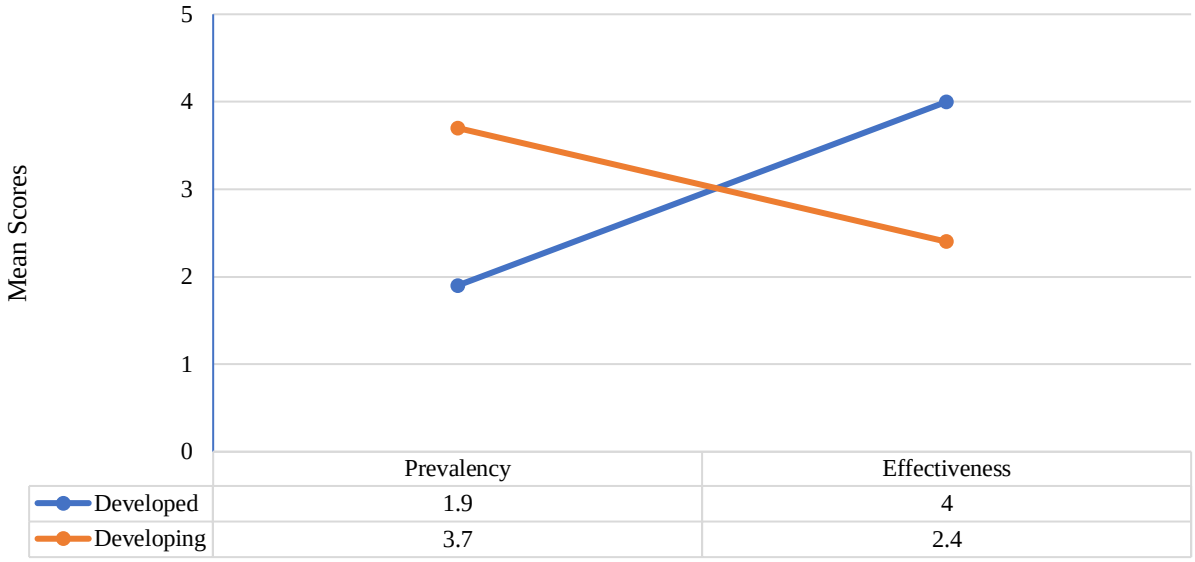
Overall, 9 activities were significantly critical or more vulnerable when compared with the related activities within their respective constructs. Analogous to the case of the developing context, all the activities in stage one (except for the receipt of tenders) were identified to be significant in the developed context. Also, at the post-contract phase, PCP4, PCP2, and PCP6 were noted as significant activities. Lastly, the selection of a contractor (CTS3) and issuance of contractual amendments (CAS1) were the only critical activities in their respective constructs. In all, ten activities were identified to be significantly vulnerable when compared with the related activities within their respective constructs in the developed context. This analysis is very important because it singles out the significant (or the more vulnerable activities) when compared in a stage-by-stage or activity-by-activity manner. These results may inform necessary industry stakeholders (such as contractors and clients) about the areas to expend more efforts and resources when attempting to eradicate corrupt practices within the procurement process.

8.2.2 Corruption Prevalence and Control in Project Procurement

Given prevailing disparities regards corruption control and the effectiveness of anti-corruption measures within extant literature, **Fig. 8.1** presents empirical evidence of respondents' responses to the differences that exist between developed and developing countries. Respondents from both

dichotomous groups were asked to indicate on a scale from 1 to 5, the pervasiveness of corruption in the modus operandi of infrastructure procurement works, and the effectiveness of the measures stipulated to combat it. Distinctively, experts from both groups demonstrate or concur with the propositions concerning the disparities. That is, whereas countries from the developed world have a relatively low prevalence of corruption and employ effective measures to mitigate corrupt practices occurring, countries from the developing world experience a high prevalence of corruption and have fewer systems to expunge or mitigate corruption. It is apparent, therefore, that the high effectiveness of the measures employed in the developed countries has contributed immensely to the low prevalence of corrupt practices and vice versa in the case of the developing countries.

Although **Fig. 8.1** concerns the subject of corruption in the procurement process; global indexes on the perception of corruption in countries for these two regions demonstrate similar ratings. For instance, the corruption perception index (CPI) statistics of Transparency International (2016), reveal that the leading 20 clean countries internationally are all from the developed economies. This affirms the notion that developing countries struggle with the development and enforcement of measures to reduce or curb the high level of corruption experienced. However, even though the results are analogous to the trending reports on corruption that exhibit disparities between developed and developing countries, this section of the study is context-specific and entrenched within the domain of construction procurement and management, unlike the general reports that encapsulate varieties of determinants of driving forces of public enterprises. More detailed comparative statistics between the two economies and the individual activities within the respective constructs are discussed in the succeeding sections.



	Prevalency	Effectiveness
Developed	1.9	4
Developing	3.7	2.4

Figure 8.1: Disparities of corruption prevalence ACMs effectiveness in the procurement process

8.2.3 Prevalent Forms of Corruption throughout the Procurement Process

This section presents the outcome for the third and final objective. Corruption has been inextricably linked to and embedded within business activities for over several millennia (Chan and Owusu 2017). The temporal evolution of corruption has led to the developments and manifestations of numerous CFs in diverse contexts. In the area of procurement and construction management, the most recent study was conducted by Chan and Owusu (2017). The authors identified 28 different CFs prevalent in construction management and categorized these CFs into five main constructs viz: bribery acts, fraudulent acts, collusive acts, extortionary acts, and discriminatory acts. Each of these five constructs encapsulates different variables. For instance, the CFs classified under extortionary acts were clientelism or client abuse, coercion, and blackmail (c.f. Chan and Owusu, ibid). These five main constructs were employed to determine their prevalence in the supply chain of the procurement process. **Fig. 8.2 and 8.3, therefore,** represent the prevalence of the CFs throughout the procurement process in the developed and developing countries, respectively.

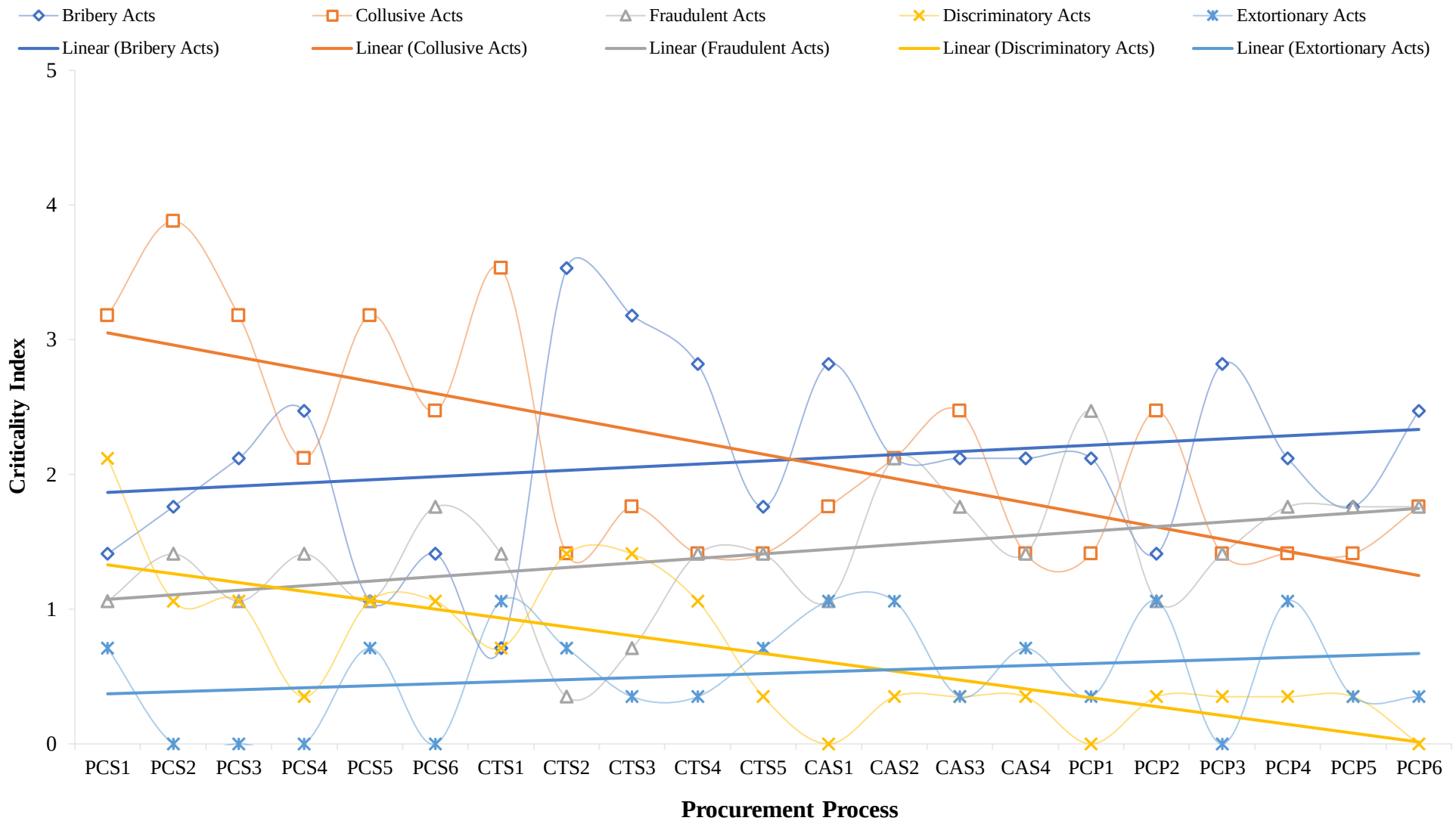


Figure 8.2: Mean indexes for CFs prevalence within the PP (Developed Countries)

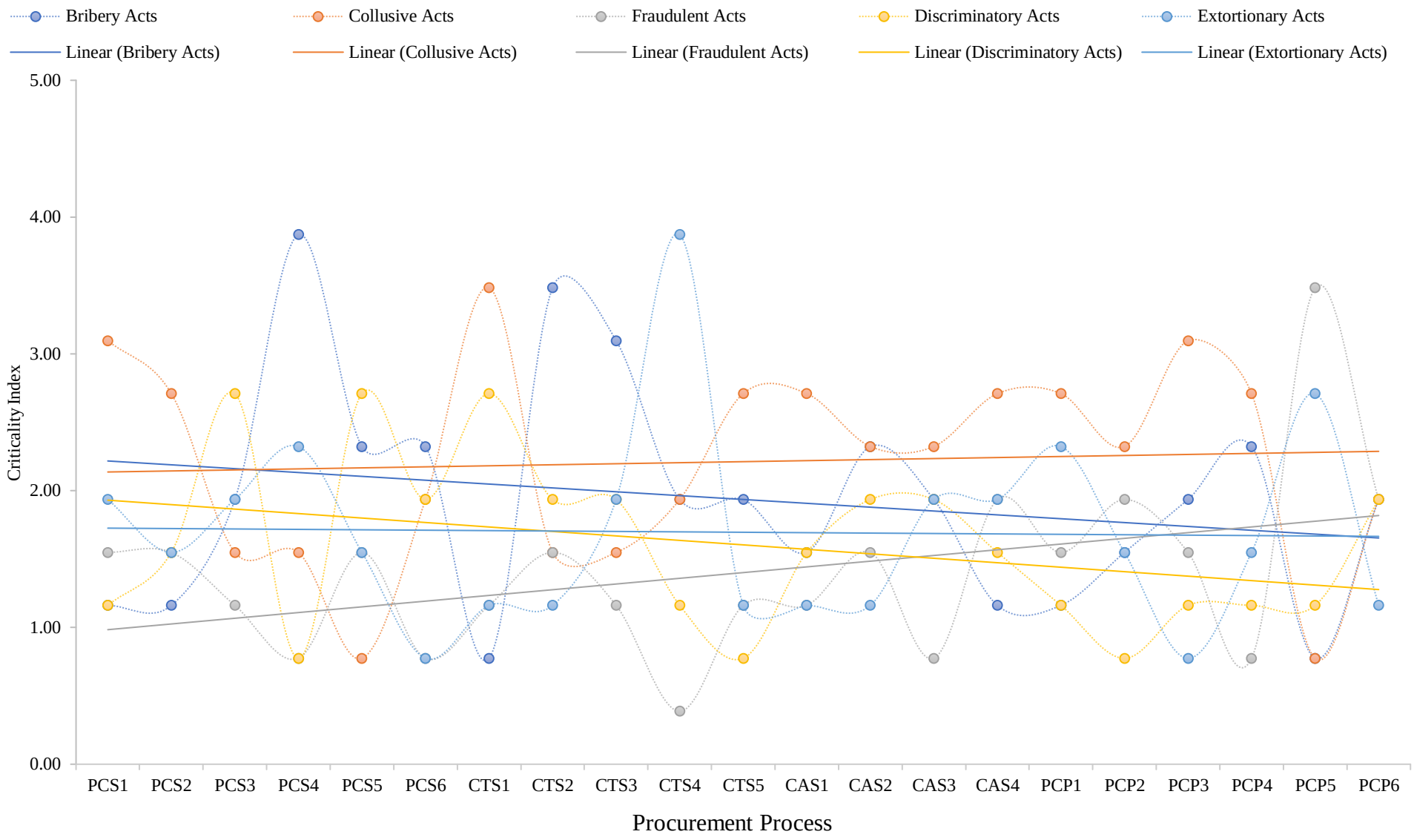


Figure 8.3: Mean indexes for CFs prevalence within the PP (Developing Countries).

Fig. 8.2 and 8.3 present the criticality, or how pervasive the five main categories of corruption forms are, throughout the procurement process and during the execution of the procurement activities, for developed and developing countries, respectively. Interestingly, the only activity (PSC1 - definition of a project's requirements) that was not statistically different (in terms of the Man-Whitney U test comparisons between the two economies) demonstrated identical levels of collusive and fraudulent practices in both contexts. The remaining 20 procurement activities were observed to demonstrate dissimilar levels of corruption form pervasiveness regarding the contextual comparisons of the two regions throughout their procurement processes.

The behavior of the corruption forms across the two contexts revealed very distinct results. With reference to the statistically significant activities identified by the Wilcoxon's signed-rank test results (presented in tables 5 and 6), the nine critical activities identified within the context of developing countries revealed that bribery acts, collusive practices and discriminatory acts were pervasive within these activities as they ranked highest in at least two (i.e., PCS5=discriminatory; PCS4=bribery; PCS3=discriminatory; PCS2=collusive; PCS1=collusive; CTS4=bribery; CTS3=bribery; CTS2=bribery; PCP4=collusive). For instance, PCS4, CTS4, CTS3, CTS2 were all identified to be plagued with bribery acts, whereas PCS5 and PCS3 also had discriminatory practices and also, PCS2, PCS1, and PCP4 were identified to be mostly plagued with collusive practices.

In contrast, the results for the developed countries revealed that out of the ten critical activities identified, six experienced collusive practices while the remaining four were plagued with bribery acts. When all 19 significant activities were considered, the three most pervasive corruption forms were identified as collusive practices, bribery acts, and discriminatory acts. Furthermore, of the four main stages in each context, these three critical corruption forms were predominantly identified at the pre-contract and contract stages in the case of developing countries and the pre-contract stage and post-contract phase in the case of the developed countries. The pre-contract stage is, therefore, the only common stage or construct across the two contexts that are plagued with corruption forms. The contract

stage is identified to be more critical or skewed towards the developing countries, and the post-contract phase tends to be critically susceptible in the developed countries.

8.2.4 Discussions

The procurement process is regarded as vulnerable to corrupt practices (c.f. Tabish and Jha 2011; Deng et al. 2014; Le et al. 2014). However, this varies across diverse norms and jurisdictions (Jain, 2001). Previous studies reported upon critical examples of corrupt practices that occur during the procurement of infrastructure works. For instance, Tabish and Jha (2011) examined the irregularities of Indian's public procurement sector and identified over 60 factors that render the entire procurement process of India susceptible to the acts and effects of corrupt practices. Similar studies were conducted in Italy, China, Indonesia, and Ghana by Locatelli et al. (2017), Le et al. (2014b), Tidey (2013), and Osei-Tutu et al. (2010) respectively. In almost all the cases, activities within the contract stage (such as evaluation of tenders and contractor selection) were besieged with corrupt practices. Since this scope has not been critically explored in different contexts, the manifestations of corrupt practices at different sections of the procurement process in different countries are not readily available in literature.

It must be emphasized that even though developed countries record low mean values regarding the criticality, this finding should not be interpreted as meaning corrupt practices were not being experienced. For example, TI's (2017) countries rankings show that all countries experience some form of corruption. Moreover, even though the contract stage in developing countries was identified to be the most critical construct, there were some individual variables within each construct or stage identified to be susceptible to corrupt practices. These include CT1, CT2, CT3, PCS4, PCS5, CAS4, PCP3, and PCP4. These activities within their respective constructs can be considered as the most critical areas to be considered in dealing with corrupt practices throughout the procurement process in developing countries. Hence, participating experts concur that if these activities within their respective stages are brought to check, corruption practices within the procurement process of most developing countries can be controlled in the short run and extirpated in the long run.

Even though all the activities recognized under the pre-contract stage, are susceptible to corrupt practices or render the entire process to the risks of the consequences of corruption, the leading activities raised by PCS4 and PCS5 are raised by the experts as the most critical area of concern. Sohail and Cavil (2007) reported the presence of some forms of corruption during this stage (i.e., pre-contract stage) in projects across diverse contexts. The authors (ibid) indicated the possibility of corruption to initiate the selection of profligate or uneconomical projects only to create some room to exploit resources allocated for the project. Examples such as political patronage, (which is captured under collusive practices in the study of Owusu et al. (2017) and financial kickbacks (identified under the bribery construct) are often identified. The typical CFs of the examples mentioned can be traced in **Fig. 8.2 and 8.3,** where the most dominating and critical forms of corrupt practices within the pre-contract stage are bribery and collusive acts. The decision making of high-level government officials and politicians who become seduced by bribery provides a typical example of how profligate projects manifest within contemporary procurement practice.

Moreover, one typical case can be traced to the highlands water project in Lesotho, South Africa. According to Wells (2015), corrupt practices were discovered when over twelve international companies and consortiums were found to have been paid bribes to the project's Chief Executive, who fraudulently awarded some of the contracts. Such acts are inevitable at the pre-contract stage where consenting parties or officials may communicate with one another or come to a common ground of distorting the process to benefit their selfish desires (Owusu et al. 2017). Other examples reported by Stansbury and Stansbury (2008) at the pre-contract stage include price-fixing by a cartel of contractors, design manipulation, and disclosure of tender information to a specific bidder.

The contract stage is the most susceptible to corruption within developing countries and the 3rd out of 4 stages within developed countries; in descending order, the noted critical stages happened to be contractor selection (CT3), tender evaluation (CT2), and contract award (CT4). However, these three activities within the CTS construct are interrelated since evaluating submitted tenders leads to the

selection of contract award to either a corrupt or a genuine bidder. Thus, once the earliest activity is corrupt, the probability that the succeeding activities would undergo similar distortions, increases.

According to Tabish and Jha (2007), some of the noted corrupt practices at this stage include bid suppression, where one or more bidders concur to either cease from bidding or withdraw tenders previously submitted. Bidders who retract their bids do so to push an agreed-upon bidder to win (Tabish and Jha 2007). This is similar to price-fixing reported by Stansbury and Stansbury (2008) where a group of bidders competing for a similar project contrive the most competitive (winning) tender while other tenderers submit overly-estimated bids. Since their intent is to share the market among themselves, they run this system in turn such that every bidder within the group wins a project. This form of corrupt practice is analogous to 'dividing the pie' as well as 'complementary bidding' (c.f. Tabish and Jha, 2007). Other forms identified and reported include low balling (which is termed as deliberate under-estimation), front companies, facilitation payment, and solicitation either by contractors or project consultants.

Respondents from developing countries indicated that the administration of the project's interim or progress payment was the most susceptible activity within the contract administration stage. This may not be unsurprising as it is closely linked to project execution. Thus, the required interim reports (e.g., specification valuations and financial claims) are susceptible to corrupt practices. Noted examples of corrupt practices include inflated claims, submission of erroneous or misleading interim certificates, concealing defects, and presenting claims for defected works as completed works.

Lastly, finalizing financial audits (PCP3) and verification of completed works (PCP4) were identified to be the most susceptible activities at the post-contract stage. Tabish and Jha (2007) and Shan et al. (2017) indicated that kickbacks are often offered to persuade inspectors (in this case, auditors) to overlook parts of the contract requirements that were unexecuted and conceal defects discovered. Thus, bribes and other facilitation payments are paid to related project officials to approve unduly executed

tasks or specify that works executed were completed in accordance with stipulated specifications. Thus, at this stage, it can be inferred or deduced that bribery acts and fraudulent practices were widespread at this stage. These reflections are depicted in both **Fig. 8.2 and 8.3** as bribery and fraudulent acts are indicated by the respondents from both contexts to be the dominant forms within this construct.

8.2.5 Section Concluding Remarks

At the outset, this section of the study sought to investigate three focused objectives to answer how susceptible the stages involved in project procurement are to the incidence of corrupt practices and also determine the critical forms prevalent at each stage in the context of the developed and the developing countries. Thus, this research presented the empirical review of international experts' opinions on the vulnerability of the procurement stages to corrupt practices and the pervasiveness of CFs in the supply chain of the procurement process. Contributing respondents expressed their opinions regarding the prevalence of corruption and the effectiveness of anti-corruption measures guiding the procurement works of their respective countries. Whereas the respondents from the developing world indicated a high prevalence of corrupt practices coupled with the low effectiveness of ACMs, respondents from the developed economies indicated the very opposite, that is, low prevalence and high effectiveness of ACMs.

Regarding the individual ratings for developed countries, the mean values for their susceptibility levels were relatively lower compared to that of developing countries. However, all the 21 activities within the four stages demonstrated significant levels in their respective ratings. Moreover, the contract administration stage had the highest level of vulnerability, and the top-rated susceptible activities were identified to be the phase (where contract amendments are issued) and at the very beginning of the process (where project infrastructure requirements are defined). In examining the prevalent CFs at the different stages of the procurement process, collusive and bribery acts were identified to be the dominant pervasive CFs throughout the procurement process even though fraudulent acts were also recorded by some of the respondents. Unlike the case (results) of developed countries, the developing

countries demonstrated a statistically different set of opinions regarding the issue of corruption in their procurement process.

First, just as the respondents indicated a high prevalence of corruption and low effectiveness of ACMs, the vulnerability levels of the stages and activities of the procurement process was relatively higher. Moreover, dissimilar to the case of developed countries, the CTS (contract stage) was identified to be the leading vulnerable stage to corruption in the developing economies, with the construct containing the first three vulnerable activities among the overall 21 stages. They are the contractor selection stage, tender evaluation, and the contract awarding stage. Regarding the prevalence of the CFs at the different stages of the procurement process, three different forms (i.e., collusive, bribery and extortionary practices) dominated the first half of the process whereas collusion, bribery, and fraudulent acts were identified to be pressing at the last half of the process. PCP1, through to PCP6, recorded high levels of collusive practices. Lastly, the MWU test results also revealed the statistically significant difference between the paired activities of the procurement process. Twenty paired activities of the developing and developed countries were identified to be different out of the 21, which indicates a very high significant difference.

With the realization of these susceptibility indexes revealed at the different levels of the procurement process (which was the main question the study sought to answer), the development of stringent and practical anti-corruption tools can be developed. Thus, the findings are beneficial not only to deepen academic understanding of the dynamics of corruption in procurement works but also beneficial to industry practitioners, policymakers, and anti-corruption institutions. Such knowledge could be used to develop specific and pragmatic corruption mitigation measures in the supply-chain of procurement of infrastructure works.

8.3 Anti-Corruption Measures

In the quest of giving a distinct definition of corruption, several works of literature on the subject matter of corruption from criminology, sociology, organizational behavior, law, and politics as well as construction management share a common consensus that the subject remains a decidedly disputed concept. To this present time, there is still an absence of resolutely grounded theories of corruption as well as a limited shared understanding (Moore 2009; Kleinig and Heffernan 2004; Williams, 2000). However, the general public to whom this social menace affects, possess very little knowledge on the different constructs of the topic (such as different forms of corruption, causes, and anti-corruption measures), the nature and behavioral dynamics of corruption in different regions and different contexts and so on. However, even though the subject of corruption tends to be extremely broad, this section of the study lends itself towards the context of construction project management.

Several studies have been conducted on this subject with the discussion of associated subheadings under the main topic and with the identification and discoveries of several causal factors influencing the nature of corruption in different construction public sectors and the management of different construction projects. The subject of corruption has been an integral causal factor of the derailment to achieving the contributing factors of the eternal triangle in construction project management (i.e., quality, time, and cost) (Shan et al. 2017; Le et al. 2014a). The destructive impact of corruption on construction projects and associated sectors include loss of human lives, short lifespan of buildings, the setback of economic growth and development, misappropriation of public funds among numerous impacts. These impacts have been discussed in several world reports, newspapers, and other scholarly works. They continue to thrive not only because of the secret or persistent thriving nature of corrupt practices but also to an extent attributed to the ineffectiveness of existing ACM stipulated to check the menace of corrupt practices. The ineffectiveness also erupts as a result of the absence of reviewing the potency of already existing ACM in CPM since a consistent review can help in eliminating the loopholes or risks associated with reviewed measures (Owusu et al. 2017; Shan et al. 2015). Measuring the effectiveness of ACM in CPM, therefore, contributes to the development of new or the enhancement

of existing ACM towards the creation of a more holistic approach in dealing with corruption in the modus operandi of CPM.

Even though some studies have been conducted on the subject of corruption in CPM, the empirical assessment of the effectiveness of ACM is relatively limited. This section of Chapter 8, therefore, examines the effectiveness of the prevailing ACM in CPM. In achieving the stipulated aim, the following objectives are set: (1) examine the level of effectiveness of each of the identified ACM in the contexts of the developed and the developing world and (2) determine the statistical differences in the level of effectiveness between the two mentioned contexts. This section of the study contributes to the strategic formulation of ACM in CPM, add to the body of knowledge on corruption-related topics in CPM coupled with the contribution of deepened understanding on the subject matter (i.e., anti-corruption measures in CPM). It serves as one of the leading references to the identification of the effectiveness of ACM in CPM.

Table 8.5: Descriptive Statistics of the Effectiveness of Anti-Corruption Measures

Code	Anti-Corruption Measures	Overall					Developed Regions				Developing Regions			
		Mean	SD	N-value	Rank	SWT	Mean	SD	Rank	N-value	Mean	SD	Rank	N-value
AC1	Transparency mechanism	3.77	1.16	0.65*	4	0.000	4.03	0.95	9	0.65*	3.50	1.30	3	0.65*
AC2	Raising awareness	3.63	1.15	0.50*	12	0.000	4.09	0.84	7	0.73*	3.16	1.25	19	0.35
AC3	Contract monitoring	3.91	1.16	0.79*	2	0.000	4.18	0.81	3	0.85*	3.61	1.39	2	0.74*
AC4	Good Leadership	3.62	1.14	0.49	15	0.000	3.97	0.95	11	0.58*	3.25	1.22	15	0.43
AC5	Education	3.69	1.10	0.56*	7	0.000	4.03	0.95	9	0.65*	3.34	1.15	12	0.51*
AC6	Contractual compliance	3.68	1.21	0.55*	8	0.000	4.15	0.91	4	0.81*	3.19	1.31	18	0.38
AC7	Whistle-blowing mechanism	3.68	1.05	0.55*	8	0.000	3.94	0.90	12	0.54*	3.41	1.13	8	0.57*
AC8	Professional associations	3.48	1.08	0.34	19	0.000	3.52	1.03	20	0.00	3.44	1.13	6	0.59*
AC9	Financial disclosure / Disclosure	3.65	1.10	0.52*	11	0.000	3.88	0.96	13	0.46	3.41	1.19	8	0.57*
AC10	Rigorous technical auditing system	4.11	1.06	1.00*	1	0.000	4.30	0.88	1	1.00*	3.91	1.20	1	1.00*
AC11	Comprehensive rules and regulations	3.66	1.08	0.53*	10	0.000	4.06	0.97	8	0.69*	3.25	1.05	15	0.43
AC12	Training and development initiatives	3.63	0.99	0.50*	12	0.000	3.82	0.88	17	0.38	3.44	1.08	6	0.59*
AC13	Ethical code	3.15	1.20	0.00	20	0.000	3.55	1.18	19	0.04	2.75	1.11	20	0.00
AC14	Debarment/ Promoting fair debarment procedures.	3.63	1.07	0.50*	12	0.000	3.79	0.82	17	0.35	3.47	1.27	4	0.62*
AC15	Procedural compliance	3.59	0.92	0.46	17	0.000	3.88	0.89	13	0.46	3.28	0.85	13	0.46
AC16	Harsh punishment or penalty	3.80	1.06	0.68*	3	0.000	4.12	0.78	5	0.77*	3.47	1.22	4	0.62*
AC17	Access to information	3.62	1.20	0.49	15	0.000	3.85	0.91	15	0.42	3.38	1.41	10	0.54*
AC18	Compliance to fairness and transparent procedures	3.75	1.12	0.63*	5	0.000	4.12	0.89	5	0.77*	3.38	1.21	10	0.54*
AC19	Rigorous supervision among others	3.75	1.02	0.63*	5	0.000	4.21	0.69	2	0.88*	3.28	1.09	13	0.46
AC20	Increase in accountability	3.55	1.13	0.42	18	0.000	3.85	0.87	15	0.42	3.25	1.29	15	0.43

Note: Cronbach's 0.935 (overall); 0.907 (Developed); 0.931 (Developing); N = 65; Critical Chi-Square value (at p value of 0.05) = 30.14; Actual Chi-Square value = 68.769; Asymp. Sig. = 0.000 (for overalls; Developed and Developing regions); Df = 19; SWT represents Shapiro-Wilk test; SWT results indicates data were statistically significantly; Normalization (N) value = (actual mean-minimum mean)/(maximum mean-minimum mean)

8.3.1 Results and Discussions

17 out of the 20 measures were identified to be less effective. Thus, supporting the views or propositions that reveals the widespread of corrupt practices in the developing world and the ineffectiveness of ACMs. In descending order, rigorous technical auditing system [AC10] was identified by the experts from the developing world to be the leading or most effective ACM in the context of the developing world. In order, words, corruption in CPM have been checked to an extent due to periodic audits of project's interim reports and other contractual documents regarding a project. With a mean score of 3.91, the experts share a common view that even though corruption in the CPM of most developing regions may be prevalent in public construction and procurement sectors. One of the reasons why the regions within the context may be making some little or good efforts to an extent towards the expurgation of corrupt acts with their accompanying detrimental effects can be attributed to the stringent auditing measures adopted in certain jurisdictions of the developing contexts.

Regular audits either on projects or public sectors may include financial audits to ensure that interim payments made correspond to the amount specified in a contract document. Others include internal or operational audits to appraise respective entities responsible for executing a project, forensic audits, compliance audits, among others (Hussain and Hadi 2018; Tan and Libby 1997; Mills 1987). Aside from auditing the process and activities involved in CPM to mitigate the risk of corruption, the act of auditing also contributes to the effectiveness of other stipulated ACMs such as an increase in accountability and transparency mechanism (Owusu et al. 2017). This variable was identified in the study of Owusu et al. (2017) as one of the most discussed probing measures. It has been adopted by several institutions such as the Independent Commission Against Corruption (ICAC) of Hong Kong (Wai 2006), Corrupt Practices Investigation Bureau (CPIB) of Singapore and other thriving investigative bodies to help reveal the secret corrupt activities prevalent in public sector projects. Comparatively, this ACM is identified to be highly significant than over 16 other ACMs, as indicated by Wilcoxon's signed-rank test result in **Table 8.5.**

The second most effective construct identified in the developed context was contract monitoring [AC3]. Contract monitoring can be described as the process of evaluating contractor's performance on the premise of quantifiable deliverables as well as verifying contractor's compliance per the requirements and conditions stipulated in the contract guiding the execution of a project (Krishnan 2009; Owusu et al. 2018; Valdes-Vasquez and Klotz 2012). Contract monitoring is somewhat analogous to contract auditing. However, whereas both are aimed at identifying potential risks or corrupt practices to provide mitigating measures, contract monitoring enhances compliable contractual performance right at the point of signing a contract throughout the contract period to contract close-out whereas auditing is performed at given intervals which may not necessarily commence immediately after awarding and signing of the contract. Moreover, contractual monitoring agencies may be different from audit institutions or parties.

This variable was as well captured by Owusu et al. (2018) as one of the most discussed ACM under the construct of probing measures. It was, however, regarded by the developing world experts through shared views to be the second most effective or somewhat successful ACM in CPM. Transparency mechanism [AC1] was the third and last most effective ACM identified in the context of the developing world's CPM. In simple terms, transparency mechanism can be described as the all-inclusive measures such as frequent stringent audits, financial disclosures, contract monitoring, etc. aimed at creating an open and accountable environment that is free from any association or identification of corrupt practices or the risks or outcomes associated with corruption. In accessing this construct in some specific developing regions, Shan et al. (2015) examined the potency of some anti-corruption strategies aimed at enhancing transparency and combating corruption in the Chinese public construction sector. Among the constructs that were assessed included stipulated rules and regulations and good leadership. Tabish and Jha (2008) and Ameyaw et al. (2017) also examined some ACMs in India and Ghana specifically to explore the nature of corruption in these regions as well as suggest recommendatory measures towards corruption elimination and transparency enhancement. Transparency mechanism was however, identified by Owusu et al. (2017) as the most discussed managerial ACM in CPM studies and was as well regarded as one of the most important and effective ACM in the context of the developing world.

In summary, the three most effective ACMs in the context of the developing world stems from only two out of the six constructs developed in the study of Owusu et al. (2018), namely probing and managerial measures. That is, whereas, rigorous technical auditing system and contract monitoring are categorized under probing measures, transparency mechanism emanate from managerial measures. Apart from these top three variables from identified under the two constructs, the remaining 17 variables, coupled with the other four constructs, were all regarded to be less effective in the developing world context.

This is further explicated by the Wilcoxon's signed-rank test result in **Table 8.6.** It can, therefore, be argued that the high prevalence of corruption in most developing regions are not only attributed to the evolution of the diverse forms of corrupt practices coupled with their associated causal measures and risk indicators but also the ineffectiveness of the majority of the stipulated ACM in existence. Bowen et al. (2012) and Ameyaw et al. (2017) specifically reported on most of the constraining factors that suppress the effectiveness of these ACM. Among the many barriers identified in the context of the developing world included political and structural constraints, psychological factors such as fear of rejection, losing job, being marginalized as well as other social and organizational obstructions. Others include organizational, social and political barriers. Therefore, devising new strategies to augment or enhance the effectiveness of existing ACM should as well consider appropriate measures needed to check the obstructing measures that tend to thwart or suppress the potency of the existing ACM.

Table 8.6: Pairwise Comparisons of the Effectiveness of ACM in the developing context

Code	AC10	AC3	AC1	AC16	AC14	AC12	AC8	AC7	AC9	AC18	AC17	AC5	AC15	AC19	AC11	AC4	AC20	AC6	AC2	AC13
AC10	*	0.460	0.021[a]	0.027[a]	0.020[a]	0.024[a]	0.041[a]	0.012[a]	0.061	0.097	0.087	0.034[a]	0.014[a]	0.032[a]	0.003[a]	0.022[a]	0.042[a]	0.021[a]	0.008[a]	0.000[a]
AC3		*	0.578	0.576	0.283	0.446	0.302	0.183	0.452	0.159	0.171	0.408	0.194	0.083	0.208	0.032[a]	0.043[a]	0.005[a]	0.007[a]	0.002[a]
AC1			*	0.821	0.987	0.645	0.907	0.834	0.875	0.569	0.461	0.505	0.346	0.385	0.115	0.203	0.323	0.189	0.104	0.002[a]
AC16				*	0.910	0.911	0.900	0.828	0.617	0.590	0.504	0.520	0.388	0.331	0.276	0.199	0.307	0.233	0.170	0.011[a]
AC14					*	0.860	0.971	0.805	0.646	0.942	0.864	0.508	0.211	0.522	0.247	0.715	0.611	0.569	0.402	0.022[a]
AC12						*	0.974	0.905	0.861	0.942	0.878	0.590	0.461	0.641	0.278	0.555	0.489	0.312	0.246	0.002[a]
AC8							*	0.884	0.672	0.850	0.924	0.537	0.314	0.603	0.344	0.870	0.680	0.578	0.460	0.016[a]
AC7								*	0.939	0.680	0.934	0.781	0.480	0.683	0.430	0.927	0.881	0.701	0.660	0.024[a]
AC9									*	0.634	0.771	0.823	0.516	0.537	0.523	0.378	0.342	0.161	0.149	0.005[a]
AC18										*	1.000	0.895	0.516	0.642	0.633	0.428	0.659	0.405	0.242	0.013[a]
AC17											*	0.918	0.663	0.648	0.907	0.538	0.526	0.293	0.182	0.011[a]
AC5												*	0.591	0.965	0.733	0.790	0.726	0.578	0.462	0.007[a]
AC15													*	0.953	0.857	0.869	0.918	0.704	0.594	0.043[a]
AC19														*	0.789	0.833	0.909	0.636	0.462	0.039[a]
AC11															*	0.875	0.930	0.778	0.619	0.030[a]
AC4																*	0.905	0.817	0.203	0.048[a]
AC20																	*	0.642	0.564	0.009[a]
AC6																		*	0.873	0.059
AC2																			*	0.035[a]
AC13																				*

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

Unlike the ratings of the developed regions, the respondents of the developed world indicated the relative importance of each of the identified ACM per their degree of effectiveness. All the ACMs were mutually concurred by the corresponding experts to be effective with the various MS ranging from 3.5-4.5. The comparative statistical significance of some of the top ACM in the context of the developed world such as [AC10], [AC19], and [AC6] are presented by the Wilcoxon's signed rank test result in **Table 8.7.** In descending order of importance, the top three most effective ACM in this context were identified to be rigorous technical auditing system [AC10], rigorous supervision [AC19], and contract monitoring [AC3].

Analogous to the findings of the developing world, two out of the top three most effective ACM were identified in this context as well. From the deductions of the experts from both contexts, even though there are numerous ACMs ranging from proactive measures to reactive measures stipulated to curb the menace of corruption in CPM, the list can never be complete without the inclusion of stringent technical auditing and contract monitoring which is inclusive of effective project supervision. Given the explications made in the previous section concerning the two identical ACM among the top three, a more detailed consideration will be conducted on rigorous supervision, which coins the other two ACMs together. The term 'supervise' stems from the amalgamation of the medieval Latin words 'super' which means over and 'videre,' meaning, to see (Merriam-Webster 2018). In short, the word is simplified to mean to oversee or manage a project. A project can never be successful (i.e., achieve the full benefit of the eternal triangle, which includes cost, time, and quality) without the appropriate stringent project supervision.

Moreover, even though stringent project supervision contributes to checking the widespread of corruption in CPM, Chan et al. (2004) identified this variable to be one of the topmost project management actions towards the realization of project's success. Owusu et al. (2017) also identified this managerial task to be one of the most discussed ACM that has a perfect indirect correlation with corruption. That is, an enhancement in project supervision decreases the tendencies or opportunities for corruption to occur. As discussed in the next section, one of the major statistical connotations that

distinguish the developed regions from the developing towards the elimination of corruption in the mentioned contexts lies in the supervision of major public infrastructural projects. There are several studies that have reported on different kinds of project failure because of poor project supervision. In the context of India, China, Ghana, and Zambia among several others, respective studies which include Tabish and Jha (2011) Le et al. (2014), Ameyaw et al. (2017) and Sichombo et al. (2009) have directly or indirectly attributed the thriving of most corrupt causal factors with associated risk indicators to the absence of effective and stringent project supervision. The difference in enforcing stringent project supervision coupled with other important ACM contribute to the wide difference in corruption prevalence and control between the developed and the developing regions. The succeeding section after **Table 8.7** indicates other significant disparities regarding the effectiveness of the identified ACM between the developed and developing regions.

Table 8.7: Pairwise Comparisons of the Effectiveness of ACM in the developed context

Code	AC10	AC19	AC3	AC6	AC16	AC18	AC2	AC11	AC5	AC1	AC4	AC7	AC15	AC9	AC20	AC17	AC14	AC12	AC13	AC8
AC10	*	0.552	0.475	0.166	0.147	0.157	0.097	0.159	0.128	0.103	0.144	0.077	0.022[a]	0.003[a]	0.015[a]	0.003[a]	0.008[a]	0.009[a]	0.003[a]	0.001[a]
AC19		*	0.890	0.635	0.548	0.518	0.594	0.500	0.511	0.319	0.256	0.124	0.019[a]	0.045[a]	0.072	0.046[a]	0.016[a]	0.096	0.009[a]	0.002[a]
AC3			*	0.723	0.785	0.512	0.461	0.475	0.320	0.197	0.197	0.219	0.117	0.142	0.052	0.092	0.031[a]	0.035[a]	0.003[a]	0.006[a]
AC6				*	0.523	0.782	0.600	0.640	0.575	0.554	0.446	0.242	0.020	0.039	0.084	0.046[a]	0.023[a]	0.070	0.011[a]	0.002[a]
AC16					*	1.000	1.000	0.646	0.695	0.688	0.376	0.198	0.096	0.278	0.109	0.215	0.068	0.210	0.007[a]	0.012[a]
AC18						*	0.957	0.751	0.906	0.670	0.540	0.299	0.083	0.135	0.097	0.109	0.032[a]	0.186	0.025[a]	0.016[a]
AC2							*	0.906	0.812	0.683	0.520	0.382	0.244	0.366	0.160	0.292	0.072	0.020[a]	0.004[a]	0.008[a]
AC11								*	0.764	0.822	0.438	0.456	0.413	0.299	0.090	0.182	0.145	0.142	0.006[a]	0.022[a]
AC5									*	0.893	0.660	0.616	0.307	0.543	0.163	0.431	0.189	0.193	0.018[a]	0.007[a]
AC1										*	0.698	0.773	0.441	0.408	0.265	0.265	0.159	0.265	0.019[a]	0.067
AC4											*	0.883	0.540	0.623	0.499	0.479	0.268	0.454	0.076	0.009[a]
AC7												*	0.663	0.667	0.660	0.575	0.320	0.557	0.122	0.028[a]
AC15													*	0.890	0.861	0.765	0.439	0.986	0.213	0.054
AC9														*	0.868	0.782	0.651	0.752	0.162	0.084
AC20															*	1.000	0.653	0.864	0.115	0.071
AC17																*	0.804	0.600	0.097	0.068
AC14																	*	0.723	0.263	0.099
AC12																		*	0.118	0.167
AC13																			*	0.873
AC8																				*

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

8.3.2 Significant disparities as indicated by the MWU test results

The MWU test results indicate that the statistical distinctiveness regarding the effectiveness of ACMs that has led to the low level of the pervasive nature of corrupt activities in the developed world. Moreover, the success in the fight against corruption that differentiates the developed regions from the developing world can be attributed to the significant variables identified by the MWU test statistics. The contextual disparities of the identical ACMs were discussed based on their respective constructs. They are promotional measures, compliance, probing, organizational, reactive, and managerial measures. The MWU test revealed that the overall variables under this construct indicated strong statistical disparities between the identical variables in both contexts. The variables captured under the compliance section included Compliance with fairness and transparent procedures [AC18], Contractual compliance [AC6], and Procedural compliance [AC15].

Even though there were clear dissimilarities in these variables concerning their levels of effectiveness, the results do not necessarily show that there is zero compliance in the case of the developing world neither do they depict full compliance in the context of the developed world. The concept of the different types or levels of compliance is presented in the study of Worthy et al. (2017). In descending order, the five levels of compliance explicated in the study of Worthy et al. (2017) are concordance, full compliance, partial compliance, lesser compliance, and non-compliance. It is, therefore, possible that the differences in the compliance levels presented by the respondents from the two contexts may range from the different levels indicated.

However, it is obvious per the MS and MWU test results that compliance with anti-corruption stipulations in the developed world CPM far outweighs that of the developed. It may, therefore, be regarded as an area of concern for the developing regions towards the enhancement and potency of the existing and new to be developed ACM. Under Probing and supervisory measures, the identical variables of both Whistle-blowing mechanism [AC7] and Rigorous supervision [AC19] [were identified to be statistically different on the contextual levels. A number of factors have been identified

in different reports as hampering measures that obstruct the effective reporting or whistleblowing in the context of the developing world. On the other hand, corruption has been checked to an extent in the developed regions partly due to the systematic and effective systems of reporting corrupt cases and checking or providing strategic measures to obliterate the obstructing measure that affect the effective application of ACM in the developed regions (Owusu et al. 2018).

Table 8.8: Mann-Whitney U Test Statistics[a] indicating significant disparities of variables

C	**AC1**	**AC2**	**AC3**	**AC4**	**AC5**	**AC6**	**AC7**	**AC8**	**AC9**	**AC10**
U	410.000	293.000	430.000	346.000	347.000	299.000	383.500	513.000	401.500	437.500
W	938.000	821.000	958.000	874.000	875.000	827.000	911.500	1041.000	929.500	965.500
Z	-1.609	-3.227	-1.371	-2.507	-2.513	-3.121	-1.970	-.205	-1.744	-1.273
P	.108	.001[a]	.170	.012[a]	.012[a]	.002[a]	.049[a]	.838	.081	.203
C	**AC11**	**AC12**	**AC13**	**AC14**	**AC15**	**AC16**	**AC17**	**AC18**	**AC19**	**AC20**
U	293.000	419.500	316.000	478.000	344.500	365.500	448.500	337.000	270.000	404.500
W	821.000	947.500	844.000	1006.000	872.500	893.500	976.500	865.000	798.000	932.500
Z	-3.223	-1.515	-2.860	-.688	-2.548	-2.242	-1.087	-2.625	-3.588	-1.706
P	.001[a]	.130	.004[a]	.492	.011[a]	.025[a]	.277	.009[a]	.000[a]	.088

Note: [a] Grouping Variable: Developed and Developing Regions; * represents C = Codes of individual ACM; U = Mann-Whitney U Test Statistics; W = Wilcoxon W; Z – Z values; P = Significance level (Asymp. Sig.)

Promotional measures such as raising awareness [AC2], holding seminars, and educating the general public [AC5] or specific class of people on the subject of corruption may not be very much enforced as compared to the others. However, it is encouraging in the developed regions as compared to developing. Aside from the statistical evidence fetched from the views of the respondents, there are a number of real-life scenarios. Some examples include the Global Anticorruption Education and Training Project (Smith 2009); the Construction Sector Transparency Initiative to promote transparency in international construction projects (World Federation of Engineering Organizations (WFEO) 2016; Krishnan 2009), Construction Industry Ethics and Compliance Initiative with the aim to promote and advance of ethical conduct and compliance in the construction industry (WFEO 2016). These are just a few of several initiatives in the developed world instigated to promote and raise awareness of how to create an ethical atmosphere in the construction industry. It also to thwart and annihilate corrupt practices with its detrimental effects not only on the construction and engineering sectors but also on projects, resources and the very lives that make use of the projects. Contrastingly, such initiative may exist on a broader scale but not specific to the construction and engineering sectors nor towards the management of

construction projects in the developed world. The disparities noted in promotional measures such as training initiatives and others reveal another area of focus that differentiates the success in the fight against corruption in the developed regions as compared to the developing. The regulatory measures identified in this section of the study were Ethical code [AC13] and comprehensive rules and regulations [AC11].

The MWU test also revealed significant statistical disparities between the developed and developing contexts concerning these measures. [AC13] which was identified by Owusu et al. (2017) as one of the most discussed ACMs, was relatively ranked lower in both contexts but identified to be significant in the developed context and the least effective ACM in the developing world. Per the results and deductions of the MUW test, it constitutes one of the primary factors that differentiate the two contexts from one another. Analogous to the reactive and compliance measures, both the MS and the MUW tests show that the effectiveness and the compliance to some stipulated ACMs contribute enormously to the success in the fight against corruption in the developed regions that differentiates them from the developing world. They include ethical and professional standards, rules, and regulations that govern the contractual demands of a project and the behavior of parties and professionals concerned with a project or in a given context. Lastly, the MUW test revealed one identical variable that demonstrated a statistically significant difference concerning the level of criticality measured between the two contexts. The identified variable is harsh punishment or penalty [AC16]. It was revealed that not only do the developed regions have effective reporting systems as well as measures to expunge the barriers that hinder the effective application of ACM but also have a stricter measure to make sure that the stipulated ACMs are adhered to. Stricter or strong regulatory system represents a sturdy indicator for a serene and corruption-free environment. On the other hand, a jurisdiction where the regulatory system is flawed with accompanying and the necessary reactive measures are not meted out in the event of a corrupt practice, that particular jurisdiction is likely to experience high-level corruption. This is common in the case of the developing regions as corrupt officials (government officials and senior management of project parties) easily get away with high levels of corruption (Ameyaw et al. 2017; Le et al. 2014; Tabish and Jha 2011; Sichombo et al. 2009). Lastly, all the identified ACM that demonstrated statistical

differences in both contexts can be argued to have resulted partly from differences associated with managerial measures such as Good Leadership [AC4]. Whereas good leadership seeks to achieve the objectives concerned with either a project or its organization, corrupt leadership in this context often looks out for any possible opportunity to misappropriate funds or resources, and where there is no opportunity, they create one (Owusu et al. 2017). The summary of the MWU test results showing the statistical disparities between the identical constructs of the two regions is presented in **Table 8.8.** Moreover, the mean disparities highlighting the effectiveness of the ACM with their associated constructs in both contexts are presented in **Fig. 8.4.**

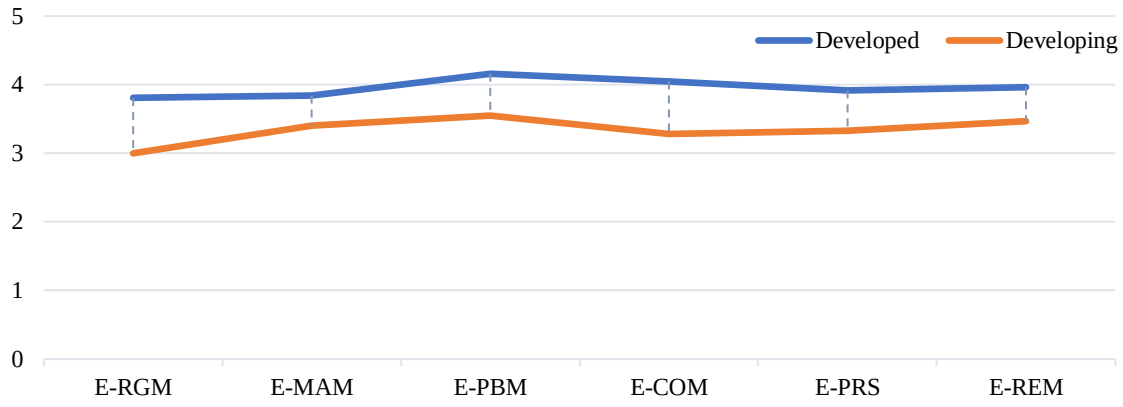


Figure 8.4: Graphical illustration of MS disparities of ACM constructs

After determining the conditions that depict that statistical differences between the two contexts, the results as well indicated that the ACMs that were identified to be effective in the developing world were statistically indifferent from the identical variables in the developed context. Therefore, the null hypotheses for the ACM, which include transparency mechanism [AC1], rigorous technical auditing system [AC10], and contract monitoring [AC3] were accepted since per the MWU test results the effectiveness of these ACMs was analogous to the case of the developed regions. The explicit distinctiveness in corruption pervasiveness and control that have been reported on longitudinal bases can be attributed to the difference in the identical variables measuring the effectiveness of ACM. It can, therefore, be postulated that giving critical attention to the areas of differences to level up the efforts of the developing regions to that of the developed will contribute enormously to the effectiveness of the

identified ACM in the developing world. Thus, aiding to the fight against corrupt practices in CPM and enhancing corruption-free atmosphere, benefiting the practice.

8.4 An empirical assessment of the Barriers

8.4.1 Introduction

This section of the chapter examines the critical barriers that obstruct the full potency and the intended effectiveness of anti-corruption measures enforced to mitigate the pervasiveness of corrupt practices in project procurement and execution. To achieve this aim, a comprehensive review of literature was conducted and resulted in the identification of 17 critical barriers. A questionnaire survey was conducted with 65 experts from around the world involved in infrastructure project procurement and management using the purposive sampling technique. The analysis was conducted on a contextual comparative basis. Thus, comparing the views of experts from the developed countries against the experts from the developing countries. The leading barriers identified by the respondents from the developing context were; the absence of political will by government officers and statutory professional councils to fight corruption and personal attitudes, which include the lack of will to become involved in fighting corruption.

The respondents from the developed world revealed that non-familiarity with ethical codes, the fear of being caught reporting, and personal attitude was the leading barriers. The Mann-Whitney U test was employed to analyze the statistical difference regarding the barriers' criticality between the two contexts. Analogous to the other sections, this section of the study contributes to a deepened understanding of corruption by examining the criticalities of barriers to the effectiveness of anti-corruption measures, which have not received the needed attention in the past years.

8.4.2 Data Analysis and Survey Results

The gathered responses were subjected to descriptive and factor analysis to explicate the issue under study. These responses represent the first empirical study to report on this subject related to barriers

that adversely affect the effectiveness of ACMs. The mentioned tools were adopted based on their ability to realize the objectives of the study. Other justifications for the adoption were attributed to the associated advantages over other tools and their wide adoption and use in other construction project management and corruption-related studies as listed in the succeeding sections. The succeeding sections present the statistical results in detail. The gathered data were analyzed using the 23rd version of the Statistical Package for the Social Sciences (SPSS) and Ucinet version 6.585.

The data were first examined to determine their appropriateness and reliability prior to further analysis because that constitutes a requirement to enhance the justifications for the results. The reliability test was therefore conducted in this study using the Cronbach's alpha test tool in SPSS. Because it is extensively used in different studies and especially in construction management-related research, the Cronbach's alpha tool was used in this study to perform the previously mentioned tasks. Given the two divisions of the total sample (i.e., 33 for developed countries and 32 for developing countries), the test was performed on each group because most of the analysis and discussions were made on comparative bases (i.e., between developed and developing countries). Complying with a scale from 0 to 1 in which 0 represents no reliability and 1 stands for full reliability, the closeness of the alpha value to 1 depicts an increasing level of reliability and vice versa with a given threshold of 0.7 (Chan et al. 2018; Santos 1999). The respective alpha values in each context are presented in **Table 8.9.**

Table 8.9: Descriptive and Mann-Whitney U Test Statistics of individual barriers

	Overall					Developed Countries				Developing Countries				Mann-Whitney U Test Statistics[a]			
Code	Mean	SD	p-value	Rank	SWT	Mean	SD	Rank	N-value	Mean	SD	Rank	N-value	U Stat*	W*	Z	p-value
BAC1	3.47	1.24	0.001	2	0.000	2.97	1.21	5	0.76 [a]	4.00	1.05	3	0.89[a]	276.500	837.500	-3.394	0.001[a]
BAC2	3.25	1.21	0.000	6	0.000	2.88	1.11	7	0.64 [a]	3.63	1.21	5	0.45	329.000	890.000	-2.755	0.006 [a]
BAC3	3.02	1.38	0.000	13	0.000	2.64	1.39	12*	0.32	3.41	1.26	15	0.19	356.000	917.000	-2.306	0.021 [a]
BAC4	3.02	1.07	0.000	13	0.000	2.58	0.97	16	0.24	3.47	0.98	11	0.26	281.500	842.500	-3.362	0.001 [a]
BAC5	3.11	1.15	0.000	11	0.000	2.64	1.06	12*	0.32	3.59	1.04	6	0.40	285.500	846.500	-3.282	0.001 [a]
BAC6	3.35	1.21	0.000	3	0.000	3.10	1.16	2	0.93 [a]	3.63	1.21	5	0.45	376.500	937.500	-2.106	0.035 [a]
BAC7	3.02	1.17	0.000	13	0.000	2.64	1.19	12*	0.32	3.41	1.01	15	0.19	327.000	888.000	-2.729	0.006 [a]
BAC8	3.20	1.19	0.000	9	0.000	2.94	1.14	6	0.72 [a]	3.47	1.19	11	0.26	398.000	959.000	-1.758	0.079
BAC9	3.06	1.04	0.000	12	0.000	2.70	0.95	10	0.40	3.44	1.01	14	0.23	306.000	867.000	-3.070	0.002 [a]
BAC10	3.25	1.26	0.000	6	0.000	2.67	1.05	11	0.36	3.84	1.19	4	0.70 [a]	225.500	786.500	-4.098	0.000 [a]
BAC11	3.03	1.09	0.000	16	0.000	2.82	1.05	9	0.56 [a]	3.25	1.11	17	0.00	392.000	953.000	-1.875	0.061
BAC12	3.20	1.18	0.000	9	0.000	2.85	1.00	8	0.60 [a]	3.56	1.24	8	0.37	326.500	887.500	-2.726	0.006 [a]
BAC13	3.35	1.39	0.000	3	0.000	2.64	1.17	12*	0.32	4.09	1.20	1	1.00 [a]	202.500	763.500	-4.377	0.000 [a]
BAC14	2.94	1.27	0.000	17	0.000	2.40	0.99	17	0.00	3.50	1.30	9	0.30	266.000	827.000	-3.522	0.000 [a]
BAC15	3.25	1.09	0.000	6	0.000	3.00	0.94	3*	0.80 [a]	3.50	1.19	9	0.30	387.000	948.000	-1.923	0.055
BAC16	3.31	1.09	0.000	5	0.000	3.15	0.94	1	1.00 [a]	3.47	1.22	11	0.26	432.500	993.500	-1.304	0.192
BAC17	3.51	1.12	0.001	1	0.000	3.00	1.00	3*	0.80 [a]	4.03	0.99	2	0.93 [a]	244.500	805.500	-3.850	0.000 [a]

Note: Cronbach's Alpha (for overalls) = 0.926; (for Developed countries) = 0.938; (for Developing countries) = 0.846; Critical Chi-Square value (at p value of 0.05) = 26.30; Actual Chi-Square value (for overalls) = 56.746; (for Developed countries) = 49.850; (for Developing countries) = 44.633; Asymp. Sig. = 0.000 (for overalls; Developed and Developing countries); Df = 16; SWT represents Shapiro-Wilk test; SWT results indicates data were statistically significantly; Normalization (N) value = (actual mean-minimum mean)/(maximum mean-minimum mean); [a] Grouping Variable: Developed and Developing Countries; U Stat*: Mann-Whitney U Test Statistics; W*: Wilcoxon W; MUW at significant; level of 0.05

Table 8.10: Degree and Betweenness Centrality of the Barriers

Code	BAC1	BAC2	BAC3	BAC4	BAC5	BAC6	BAC7	BAC8	BAC9	BAC10	BAC11	BAC12	BAC13	BAC14	BAC15	BAC16	BAC17
Dpd/DC	6.608	8.071*	5.419	7.659	7.905	6.654	7.755	7.657	8.168	7.965	7.894*	7.742*	8.544*	2.211	4.367	2.897	4.874
Dpg/DC	0.923	4.308*	2.593	2.315	4.509	2.830	5.123*	3.320	3.247	3.418	3.020	3.490	1.253	2.957	4.632*	4.915*	2.407
Dpd/BC	1.531	7.033#	1.547	1.639	1.964	3.603	5.008	2.033	3.161	5.097	8.647#	12.800#	8.158#	0.100	3.056	0.211	4.411
Dpg/BC	0.000	14.867#	0.000	0.200	4.367	0.575	31.200#	0.775	5.350	6.883	3.233	0.775	0.200	13.842	9.317#	17.417#	1.000

Note: Dpd = Developed countries; Dpg = Developing Countries; BC = Betweenness centrality; DC = Degree centrality; *# top nodes/barriers with a relatively higher degree values of centrality* and betweenness #

8.4.3 The criticality of Individual barriers of both contexts

It was not surprising to notice that the factors received relatively lower ratings by the respondents from the developed world. **Table 8.9** presents the individual ratings for the barriers for both contexts as well as the amalgamated results of the two contexts (i.e., the overall column). All the individual ratings from the developed world experts were approximated to be either neutral or less critical as predefined by the Likert scale. However, despite the low ratings, it is not unnecessary to highlight the factors that received high rankings regarding the position or how the experts view these barriers. Therefore, the experts from the developed world share a common consensus that knowledge gap or non-familiarity with organizational stipulations limit the potency of anti-corruption measures in infrastructure projects in the developed context even though it had a lower rating with a mean value of 3.10. This is interpreted from the context of not just knowing the ethical codes but also knowing what ought to be done and not doing it (Owusu et al. 2017, Zhang et al. 2016; Le et al. .2014).

This may relate to one of the critical barriers observed in the case of the developing countries as well. On other occasions, since some parties may already know the punishments that are meted out in the case of any corrupt activity, the motivation to indulge in a corrupt act outweighs the fear after weighing the advantages and risks involved in whether to indulge in a corrupt activity or not. Therefore, just like in the case of investments, the portfolio that offers a high rate of return is worth investing in. Thus, parties may get involved because of the projected high rate of returns coupled with the low risk of getting caught or reported. Some of the leading barriers included the fear of being caught reporting, [BAC6] which came second with a mean score of 3.10, inappropriate staffing [BAC15] and the lack of will to become involved in fighting corruption [BAC17], both placed third with a mean score 3.00 each. It was, however, quite startling to notice that fear of being caught reporting would be regarded as one of the top three barriers in the context of developed countries despite the practical measures implemented to ensure safe and efficient reporting of corruption cases in the developed world.

In the case of the Developing world, corruption continues to hit the headlines on daily bases with confirmations from the reports of top global indexes such as the corruption perception index by Transparency International, the Worldwide Governance Indicators by the World Bank, the Global Competitiveness Index by the World Economic Forum among many others. The situation of corruption in the developing world does not seem to improve, and in some cases, the reports indicated above reveals the declination in performance by most countries in the developing world as well as the challenges that impede the progress or developments towards the expurgation of corrupt practices. Not contradicting this background, it is worthy to note that most countries have taken great initiatives and tremendous efforts by developing and enforcing practical measures to curtail corruption. However, just as described in the previous sections, it is in these instances that these barriers also emerge to hamper the effectiveness of the stipulated anti-corruption measures.

Moreover, most developed anti-corruption measures do not cater for the barriers that hamper their effectiveness but are rather concentrated solely on eliminating the forms, causal factors, and the identified risk indicators involved. It is, therefore, needful, to create a pragmatic and holistic approach in dealing with corruption-related issues. Thus, encapsulating all the mentioned constructs of corruption as well as supplementary incorporations of strategies to deal with anticipated barriers against anti-corruption measures. The leading barriers that emerged in the case of the developing context were political barriers as they were recognized in their individual criticalities and also as a construct, as discussed later in this section. Lack of political will by government officials and statutory professional councils to fight corruption [BAC13] as well as political and structural barriers [BAC1] came first and third place respectively with their corresponding mean scores at 4.09 and 4.00. Since the factor analysis clustered these two variables into a single construct, a detailed discussion on these two variables are given at the construct criticality section. Personal attitude, for example, lack of will to become involved in fighting corruption [BAC17] was identified to be the second critical barrier in the developing world context with a mean score of 4.03. Just as Boyd and Padilla (2009) pointed that whenever there is a case of corruption, the key identified parties include the demand side (the party that calls for the corrupt act to be done), the supply side (the party that pays or offers the price for corruption) and the condoning

side (the party that remains silent in the case of corruption). BA17 concerns or correlates most with the third party (i.e., the condoning side). Even though society may frown upon this act; it should be noted that some studies point out the justifications with which some people decide to fall into the category of the condoning side (Boyed and Padilla 2009). Owusu et al. (2017) indicated that some of the general factors with which the condoning parties stand on to justify their actions might stem from the lack of trust in the context in which they work and the presumption that no better results will evolve even in the event of reporting. Others include the associated risks attached to the disclosure of corrupt acts in a given context; and the perception that no disciplinary actions will be taken against the culprit after reporting. Therefore, to be in an undisturbed zone, the condoning party may opt to remain silent in the event of a corrupt activity. Other factors such as the dread of being victimized, the fear of being marginalized, social or occupational stigma and rejection contribute to condoner's justification to keep silent during the event of corruption related to loyalty to friends and organizations (Shan et al. 2015a; Ameyaw et al., 2017; Bowen et al., 2012).

8.4.4 Individual Comparability

As pointed in the previous section, the Mann-Whitney U test was conducted to determine the statistical differences of criticality between the identical barriers of the two contexts (i.e., developed and developing). With the prior supposition or null hypothesis stating that there is no difference in terms of the degree of criticality concerning the barriers, the null hypothesis were rejected in all cases except for BAC8, BAC11, BAC15 and BAC16 where the significant values exceeded 0.05 (meaning there is no significant statistical difference in the mentioned variables). The Mann-Whitney U test results partly confirm the reports on the perception of corruption prevalence and control in these two contexts by world reports stated earlier even though the results in this section are more skewed towards the field of construction management and infrastructure procurement. The experts from the two different regions, therefore, attest to the notion that there are differences regarding how the identified barriers affect the modus operandi of construction project management. This is indicated by the mean values in each context coupled with the Mann-Whitney U test results. That is, whereas respondents from the developed

context attest to the low or neutral levels of the criticality of all the barriers, most of the barriers were identified to be critical in the context of the developing world. Thus, confirming a sharp statistical distinction of the barriers in the two contexts as revealed by the Mann-Whitney U test.

8.4.5 Factor and Network Analyses Results

FA was performed to identify the statistical correlations among the variables and to categorize them into their associated constructs. Even though the factor analysis draws significant constructs after some number necessary rotations, the network analysis amplifies the correlations by highlighting the variables' degree of betweenness and centrality. **Table 8.11** presents the summary of the factor analysis results and **Fig. 8.45 and 8.6** illustrates the graphical presentation of the network analysis results.

Table 8.11: Factor Analysis of Barriers in both contexts

Developed Countries				$\bar{x} = \sum xi/_n$	Developing Countries					$\bar{x} = \sum xi/_n$
Code Variable	SB	PPB	OB		Code Variable	PSB	SB	OB	PB	
Social Barriers (SB)				***2.734***	Psychological barriers (PSB)					***3.507***
BAC5	.846			2.64	BAC12	.861				3.56
BAC10	.843			2.67	BAC6	.835				3.63
BAC4	.828			2.58	BAC8	.803				3.47
BAC7	.794			2.64	BAC11	.783				3.25
BAC6	.721			3.10	BAC2	.741				3.63
BAC11	.671			2.82	BAC14	.569				3.50
BAC9	.580			2.70	Social Barriers (SB)					***3.538***
Psycho-political Barriers (PPB)				***2.845***	BAC10		.832			3.84
BAC13		.818		2.64	BAC3		.773			3.41
BAC3		.760		2.64	BAC5		.713			3.59
BAC1		.713		2.97	BAC7		.697			3.41
BAC17		.694		3.00	BAC9		.550			3.44
BAC2		.665		2.88	Organizational Barriers (OB)					***3.618***
BAC8		.599		2.94	BAC17			.771		4.03
Organizational barriers (OB)				***2.850***	BAC4			.753		3.47
BAC16			.804	3.15	BAC15			.707		3.50
BAC14			.605	2.40	BAC16			.690		3.47
BAC15			.596	3.00	Political Barriers (PB)					***4.045***
BAC12			.568	2.85	BAC13				.698	4.09
					BAC1				.581	4.00
Eigenvalues (EV)	8.807	1.851	1.463		Eigenvalues (EV)	5.230	4.117	1.466	1.054	
Variance (VA)	51.803	10.891	8.608		Variance (VA)	30.762	24.217	8.626	6.200	
Cumulative Variance (CV%)	51.803	62.694	71.302		CV%	30.762	54.979	63.605	69.805	
N-values	0.000	0.957	1.000		N-values	0.000	0.0576	0.206	1.000	
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.				0.765	Kaiser-Meyer-Olkin Measure of Sampling Adequacy.				0.568	
Bartlett's Test of Sphericity Approx. Chi-Square				462.495	Bartlett's Test of Sphericity Approx. Chi-Square				341.126	
df			136		df				136	
Sig.			0.000		Sig.				0.000	

$\bar{x} = \sum xi/_n \ldots equation$ (1); where $\bar{x}$ represents the mean, $\sum xi$ is the summation of sampled values or frequency; n represents number of respondents or items.

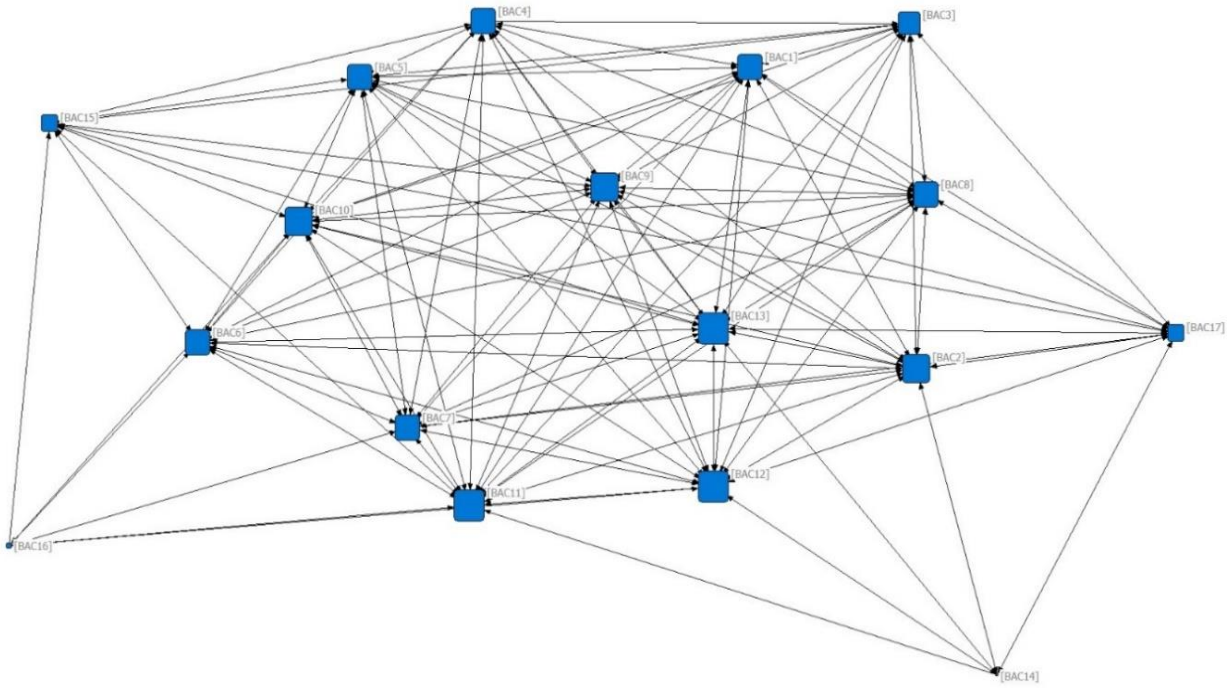


Figure 8.5: Network Analysis of the ACMs barriers in the developed context.

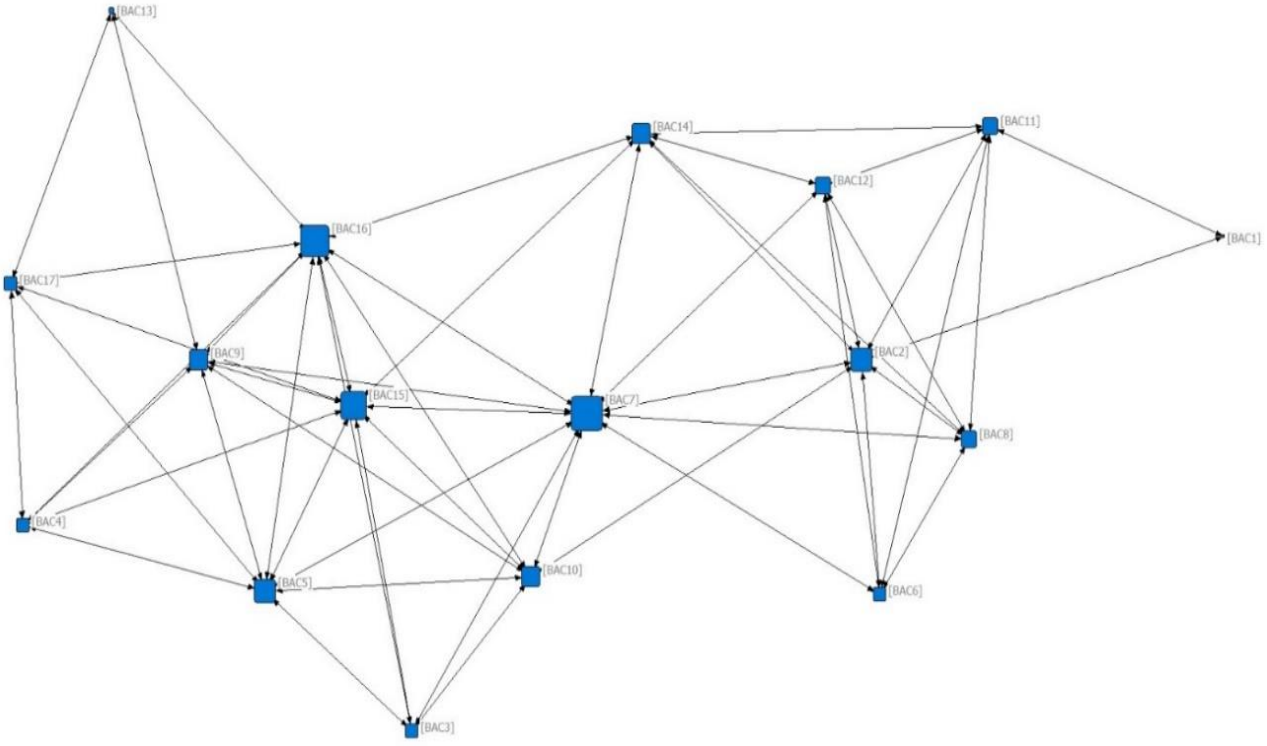


Figure 8.6: Network Analysis of the ACMs barriers in the developing context.

Of the several SNA technique metrics such as the clustering coefficient, eigenvector centrality, bridge, cohesion among other metrics, the four most widely adopted measures of centrality include the eigenvector centrality, degree centrality, closeness and betweenness (Scott 2017; Freeman 2011). However, this section employed two out of the four common techniques.

The two techniques adopted are the degree of centrality and betweenness. These two measures of centrality were considered adequate and apropos to execute the objectives for which the SNA technique was adopted. In a nutshell, even though the technique is employed to connote or represent a complex set of relationship between individuals in the social structure and the different kinds of interdependence, the degree of centrality and betweenness were employed in this section to illustrate the degree or extent of the relationship among the variables or nodes, (i.e., barriers) under the two given contexts. With the centrality measuring the critical power of nodes based on how well they connect the network, the betweenness depicts the extent to which a node or variable lies amid other nodes of variables in the network (Scott 2017; Kim and Hastak 2018).

Even though the inference from the application of the network analysis technique is to supplement the degree of relationship presented by the factor analysis results, the conclusion drawn from this approach indicates that the elimination of one barrier can greatly influence or affect the performance of another in a given context. It can therefore be seen from **Fig. 8.5 and 8.6** that the degree of relationships (i.e. the degree of centrality and betweenness) of the nodes vary in the two contexts. Whereas the graphical presentation in the case of the developed world demonstrates a relatively higher degree of correlated nodes, the case is somewhat loosed in the developing world. The elimination of the nodes with a high degree of centrality such as BA2, BAC11, BAC12, and BAC13 in the developed context as well as the nodes BAC2, BAC7, and BAC16 in the developing context will, however, cause a very high significant impact on the other nodes and the entire network.

In effect, the implication or inference that can be drawn is that it will be easier to eliminate these nodes barriers in the developed context due to their close connectivity and the influence of one node on the

other than in developing context which depicts a relatively loosed node-connectivity in the network regarding the degree of centrality and betweenness. However, this conclusion can be regarded as a supposition until it is tested on real-life projects.

8.4.6 Construct's Criticality

The identified barriers were regarded suitable for factor analysis in both cases due to the realization of meeting the requirements, which include the KMO and Bartlett's sphericity test. Both the KMO and Bartlett's Test of Sphericity of the two respective regions is presented in **Table 8.11**. The correlation matrices in both cases were identified to be nonidentity matrices, thus suitable for further analysis. The correlations among the variables were also sturdy in both contexts, even though stronger in the results for the developed context than the developing. This is confirmed by the network structures in **Fig. 8.5 and 8.6,** as well as **Table 8.10**. From both figures, the correlated variables are higher in the case of the developed than in the developing. This can be explained in two dimensions, namely betweenness and degree centrality.

Lastly, the variances in both cases were as well adequately homogenous, hence, apropos for factor analysis. With the application of the principal component analysis coupled with varimax rotation methods, the factor analysis rotations generated three distinct components under the developed context, and four under the developing context with their respective eigenvalues and total variance explained presented in **Table 8.11**. All the generated factors in each case satisfied both the eigenvalue criteria of 1.0, as well as the total variance explained over 70% in each case (Norusis 2008). The naming of the components was done using the common themes that run through the variables (Owusu et al. 2017; Chan and Owusu 2017). Moreover, in the case where no common theme exists, the naming was done using a combined theme of the variables with the maximum cross factor loadings and discarding the ones with lower loading (i.e., <0.4) (Zhang et al. 2016; Le et al. 2014). The shared themes that run through all the components were relatively similar. Moreover, a second technique to supplement the categorization of the constructs was adapted from the study of Lee et al. (2004). Since the factor analysis

technique was employed to analyze the same variables under two different contexts, a higher probability of unequal generation of the components or factors was anticipated. Simply put, it was expected that should there be three constructs formed under the developing contexts, the case of the constructs development in the developed context is likely to vary. This, therefore, triggered the adoption of a common label for a construct that shares at least two identical variables under the two different contexts. For instance, the construct labeled Social Barriers was developed in both contexts because they shared four identical variables (i.e., BA5, BA7, BA9, and BA10). Therefore, even though other variables were found under the same construct, to harmonize and structure the labeling of the factors in a systematic order, the approaches of Zhang et al. (2016) and Lee et al. (2004) among similar studies were identified to be apropos for adaption.

However, one component named psycho-political in the context of the developed countries was split into two stand-alone constructs, namely psychological barriers and political barriers in the case of the developing context. In descending order, the three components in the developed context were organizational barriers with a construct mean of 2.850, psycho-political barriers, and social barriers with mean values of 2.845 and 2.734, respectively. Ranking from top to bottom, the constructs developed in the context of the developing countries are political barriers with MS of 4.045, psychological barriers, social barriers and organizational Barriers with respective means of 3.618, 3.538 and 3.507. Unlike the causal factors that trigger of corruption in construction projects, the barriers to the effective enforcement and application lend themselves to administrative concerns rather than project concerns even though these barriers have either direct or indirect influences on projects.

8.4.5.1 Political Barriers

Political barriers connote the obstructing measures posed by government officials (use or abuse of power) directly or indirectly to thwart the effective functioning and enforcement of anti-corruption measures (Owusu et al. 2017; Bowen et al. 2015). These kinds of barriers are often critical in kleptocracy states where governments commonly account to no external authority and abuses delegated power to exploit state's resources. In effect, officials extend their power to boomerang sanctions in

situations they are recognized to be offenders or culprits. This is largely identified in the procurement of infrastructure works where large sums of monies are expended. It was, therefore, not surprising to identify the political barriers as the leading construct to obstruct the effectiveness of ACM measures in the developing world, especially given the weak political systems in most developing countries. The leading barrier identified under this construct was the absence of political will, which is explicated to be the political unwillingness by statutory councils and government officials to fight corruption since they may be involved in it one way or another. This variable had the overall highest MS of 4.09 in both contexts. The second variable in this construct is political and structural barriers with MS of 4.0. This signifies that the primary area of concern with respect to dealing with the barriers to the effectiveness of ACM in the developing world should always start from the top.

8.4.5.2 Psychological barriers

Psychological barriers happened to be one of the stand-alone constructs in the developing world context. Even though it was the least ranked construct, it had the highest number of variables per the results of the FA. Psychological barriers can be described as human-related factors (psychosomatic, mental or emotional) that affect one's behavior in a given setting and under a given condition (Owusu et al. 2017; Greitzer 2013). Therefore, the response to an act in a given situation is influenced by the psychological make-up of a person. However, one's disposition towards the fight against corruption is not only influenced by external factors such as institutional structures but also the influence of the external factors on his psychological make-up. Studies, therefore, pointed that most ACMs in the context of the developing world are not effective as they ought to be due to the psychological restraints captured under this construct (Bowen et al. 2012; Ameyaw et al. 2017). Per the results, the top three variables identified under this construct included the fear of being caught reporting coupled with the fear of insecurity which includes dread of losing one's job and the perception of no better result, distrust in system (Shan et al. 2015b; Alutu 2007; Bowen et al. 2012). The lack of trust in the governmental and institutional structures in developing countries has been one of the paramount obstructions to the effectiveness of ACMs in the developing context (Owusu et al. 2017). With the notion and perception that either less or no rigorous efforts would be taken by states to bring offenders and culprits to check, put a high percentage of the

general populates to either report a corrupt practice. Other variables identified in this construct included bureaucratic process of reporting corrupt cases and lengthy processes of reporting corrupt cases. Inappropriate internal institutional coordination / inter-agency relations and the lack of understanding and knowledge of their rights within a contractual environment, difficulty in providing concrete evidence, were all identified to be critical barriers (Owusu et al. 2017; Shan et al. 2017; Stansbury 2009; Bowen et al. 2012).

8.4.5.3 Organizational Barriers

The barriers that contribute to the ineffectiveness of ACMs are not only limited to political or human-related factors but also organizational or institutional factors. These are either direct or indirect factors associated with or stemming from institutions involved in the realization of construction and other infrastructure projects. The OG construct forms one of the two categories developed under the two contexts (i.e., developed and developing countries) due to the commonalities that exist between the two. Per the normalization values, this construct is highly relevant in the developed context as compared to the developing even though its MS in the developing countries is more significant as compared to the developed. It can, therefore, be considered to be relevant in both contexts as compared to the other shared construct. The shared barriers between the developed and the developing included the lack of knowledge or non-familiarity with ethical codes/ organizational codes of ethics and Inappropriate staffing (Bowen et al. 2007; Stansbury 2009; Shan et al. 2015b). Other obstructing factors exclusive to only the developing countries included personal attitude, for instance, in a situation where people are not concerned with fighting the pervasiveness of corruption and social misrepresentation. In the context of the developed world, the organizational barriers specific to this context included the lack of understanding and knowledge of their rights within a contractual environment, difficulty in providing concrete evidence and lastly the perception of no better end result, distrust in system (Ameyaw et al. 2017; Chan and Owusu 2017; Zou 2006; Iyer and Sagheer 2009).

8.4.5.4 Psychosocial Barriers

Following the attributes of psychosocial-specific causal construct that was developed in the study of Owusu et al. (2017), the psychosocial barriers can simply be defined as the relationship that exists between the psychological attributes or behavior of a person and or on social or environmental factors. The barriers under this construct, therefore, reveal the psychological connotations of a person as influenced by the environment that causes a person to act lackadaisically towards the enforcement or application of enforced ACMs or rather disregard stipulated ACMs which in turn contributes to the pervasiveness of corrupt practices and the ineffectiveness of ACMs. Most of the social barriers against the effectiveness of anti-corruption measures exist because of the negative strings and the harmful effects attached to it. Krishnan (2009) presented several examples from different international reports on why most people fear to report corrupt cases or aid to the effectiveness of ACMs.

Among the examples was death report on a civil engineer from India who blew the whistle against a corrupt act. No one would prefer to go through such experience for reporting a case may be indirectly connected to him. However, because there may be no stringent stipulations instituted to protect whistleblowers or potential candidates who aim to help curb corruption, the situation worsens especially in the developing world. This construct was identified in both the developed and the developing world because they shared common underlying variables, which are fear of victimization, fear of being marginalized, social or occupational stigma and rejection and lack of independence (Bowen et al. 2012; Krishnan 2009). Other critical barriers identified include fear of losing life in the context of the developing world and social misrepresentation, fear of being caught reporting, and the inappropriate coordination of internal structures of an institution/ interagency relation (Ameyaw et al. 2017; Krishnan 2009; Stansbury 2009). Effective ACMs targeted at eliminating psychosocial and project-specific causal factors of corrupt practices may incorporate strategies for curbing the identified variables under this construct. original

8.4.5.5 Psycho-political Barriers

The validity of the term psycho-political was coined by Prilleltensky (2003), which was defined as a way to assess the psychological patterns of a person or a given group of people within an organization or a community and their responsiveness to and engagements with the dynamics of power, analysis of structural levels and social justice promotion. Thus, the term amalgamates the interplay of the theories behind psychology and politics and the inference of the term on human behavior towards political, structural, and social stipulations and enhancements. This construct came second place with MS of 2.845. Even though the MS indicates a neutral level of criticality, the normalization value indicates a high level of significance of the construct's criticality, which is 0.957.

Five variables were captured under this construct, and they are lack of political will, a lack of political will by government officials and statutory professional councils to fight corruption, political and structural barriers. The remaining were personal attitude, for example, lack of will to become involved in fighting corruption, fear of insecurity which includes fear of losing job and the bureaucratic process of reporting corrupt cases (Porter 1993; Tabish and Jha 2011; Sohail and Cavill 2008; Ameyaw et al. 2017; Bowen et al. 2012). The distinct demarcation between the two constructs lies in the notion that. In contrast, psycho-social barriers are more centered on the correlations and the influences of psychological factors on social behavior and vice versa, the psycho-political construct, on the other hand, demonstrates the relationship and influences between psychological factors and political or governmental structures. **Fig. 8.7** presents mean indexes of the constructs developed for each context.

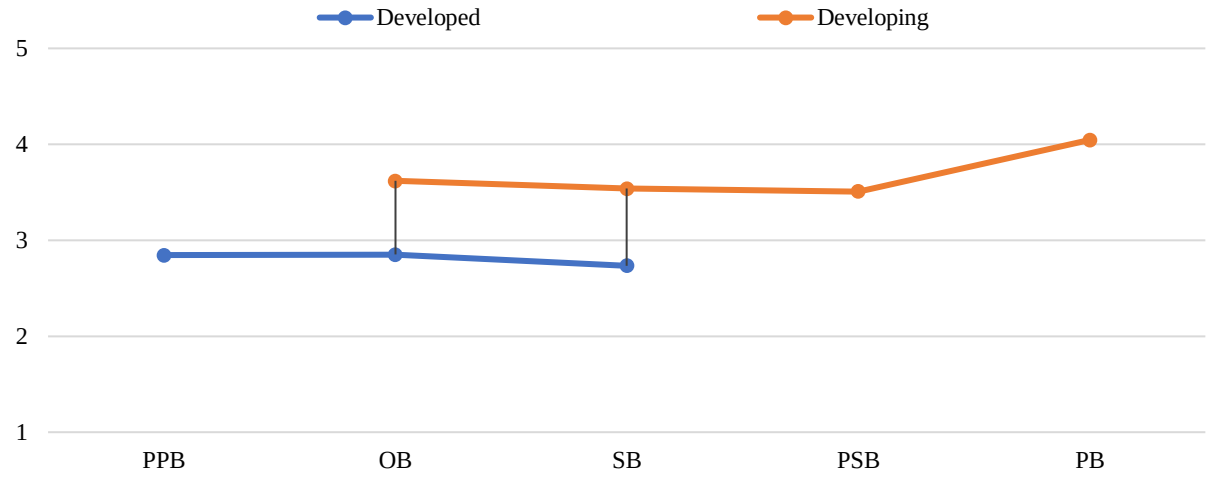


Figure 8.7: Constructs' Comparison of the developed and developing contexts

8.4.7 Section Summary

This section of the study sought to conduct an empirical survey on the barriers that hamper the effectiveness of existing anti-corruption measures developed to mitigate corrupt practices in the procurement and management of construction and other infrastructure-related works. The rationale stems from the reported notion that despite the good efforts in implementing anti-corruption measures to mitigate the prevalence of corruption in projects and the industry, the accounts for factors that normally obstruct the effectiveness of these measures are not fully considered (Bowen et al. 2012; Owusu et al. 2017). Literature as well remains silent on this issue even though due considerations and attention have been given to other constructs of the subject matter of corruption. Therefore, in order to aptly reach the target, four objectives were set. The second objective was to examine the criticality of the factors or variables collated during the review study with experts from different contexts (primarily segmented into emerging and established economies or jurisdictions). The results revealed the unwillingness of people to get involved in the fight against corruption represents the number one impediment to the potency of existing anti-corruption measures. Other critical factors included political and structural barriers and the fear of being caught reporting. Even though a number of constructs namely psychological, social, organizational, political, and psycho-political, emerged after the variables were categorized using the factor analysis technique, the root cause or rationale underpinning the

unwillingness of persons to get involved in the fight against corruption needs to be examined in the future. Using a total number of 65 responses which were regarded valid for the data analysis, 33 of the responses came from experts from the developed countries and 32 from the developing. Moreover, in determining the statistical significant difference between the views of the respondents of the two contexts, the Mann-Whitney U test results indicated that four identical variables (BAC8, BAC11 BAC15, BAC16) were identified to be statistically insignificant in terms of their differences. However, the remaining thirteen variables were identified to be statistically significant regarding the differences in their levels of criticality. In essence, it can be deduced that whereas these thirteen barriers may be considered critical by the views of the respondents from the developing context, the case is somewhat different per the views of the experts from the developed context.

The practicality of corruption research aimed at annulling the menace in projects and the industry is as well hindered by these factors, which this study reports (Ameyaw et al. 2017). Even though this section of the study may be subjected to a number of limitations, there is no doubt that theoretically, it contributes to the body of knowledge on the subject matter of corruption in addition to a deepened holistic understanding of the topic of corruption in construction management research. It extends the body of knowledge by first conducting a systematic review of the barriers and empirically examines their criticality in relation to infrastructure procurement. Aside from the individual levels of the barriers' criticalities, this section also reveals the factors that have stronger influences on factors when viewed under the scope of their connectivity in a network. Thus, informing anti-corruption practitioners on probable areas to tackle first in dealing with these barriers. Practically, as academic and industrial researchers continually develop tool kits, frameworks, and policies against corrupt practices, this section is intended to extend the coverage of dealing with corrupt practices. This section practically reports on taking a further step in the approach in combating corruption by extending the scope beyond the traditional causal factors with their associated vulnerabilities to cover the barriers that impede the efficacy of existing anti-corruption measures.

8.5 Exemplary Lessons: The Case of Hong Kong[14]

Throughout history to this very day, the notion and practicality of building a clean city is not only attributed to the tangible and measurable elements around us such as clean air, high mobility healthy and sustainable buildings among others but also the intangible characteristics that make up the city and the people within it such as behavior, morality and ethical standards (Chan and Owusu 2017). As such, while there are progressive scholarship and contributions towards the measurable components of a city, the situation is somewhat opposite for the case of the intangible attributes of what makes up a clean city. The subject of corruption has not been only a scholarly topic studied for the past centuries but also a devastating socio-economic issue that has lived with humans for more than five millenniums (Noonan 1984). Even though corruption is regarded as the exploitation of public resources for private gain in diverse contexts including the social and political settings, the context of procurement regard corruption as the distortion of any of the stages within the procurement process with the intention of misappropriating project's resources (Le et al. 2014; Owusu et al. 2018). The resources may range from monetary to valuable properties and other gains, such as illegal favors, among others (Stansbury and Stansbury 2009).

Several studies have been conducted to explore the diverse constructs of corruption in order to demystify the complex and clandestine nature of corrupt practices to identify its causes, contextual risks indicators, anti-corruption measures and the barriers that hinder the effective application of anti-corruption measures not only in the political and business arenas but also in the procurement, execution, and management of infrastructure projects (Le et al. 2014; Owusu et al. 2017). This section focuses on anti-corruption measures, which may be regarded as the tools, policies and frameworks developed and enforced to thwart the incidence and proliferation of corrupt practices in the short term as well as extirpate its effects in the long run (Shan et al. 2015). Even though some studies regarding the generic

[14] Owusu, E. K., Chan, A. P., Yang, J., & Pärn, E. (2020). Towards corruption-free cities: Measuring the effectiveness of anti-corruption measures in infrastructure project procurement and management in Hong Kong. *Cities*, 96, 102435.

application of these established measures have been conducted, not many works have been undertaken on the specificity of their application, especially in the context of infrastructure procurement and management. Moreover, the contextual explorations on the subject matter remain few with a number of the empirical studies focused on the developing countries (Ameyaw et al. 2017; Tabish and Jha 2012; Shan et al. 2015; Zou 2006; Sichombo et al. 2009) among others. This section, however, advances the existing knowledge by conducting an empirical assessment of the comprehensive list of the anti-corruption measures in the developed region with other vital measures, peculiar to the context. With this being one of the first empirical studies to be conducted in a developed context, policymakers, and project stakeholders in other developed contexts to assess the performance of projects regarding their resistance to corrupt activities and, in turn, assess the effectiveness of anti-corruption measures.

8.5.1 Pretests

In advance of the commencement of detailed analysis, there is a wide consensus among different scholars on the need to determine the statistical normality and reliability of the data to be analyzed (Spiliotopoulou 2009; Santos 1999; Shan et al. 2017). The determination of these two tests is considered to be vital as they form part the basic and most important pre-tests to be conducted as well as their ability to influence the selection of suitable statistical tools and techniques to be adopted (in the case of examining data normality). Moreover, they determine whether further analysis of the data can be conducted (in the case of reliability). The data reliability was determined by conducting the Cronbach Alpha's (CA) test. Per the stipulation of Nunally (1978), the threshold for establishing a statistically reliable dataset should not be less than 0.7. With the given range of 0 to 1 as the extreme variants, the greater the calculated reliability nears zero, the lesser its reliability and vice versa. Zero, therefore indicates no reliability, whereas one indicates full reliability. The actual estimated CA for this section of the study was 0.958, which reflects an extremely high level of reliability. However, the second pre-test (i.e., data normality test) was not conducted as the tools employed in this section of the study did not require any pattern of the distribution of data (whether normal or non-normal).

8.5.2 Mean Index Estimations

The mean index approach was primarily adopted to examine the variable identified at first hand. As a standard tool in research, the mean technique is often used to determine the central tendency a given data (Kothari, 2004). Mathematically, the mean index for the variables is estimated using the formula below:

$MI = {\Sigma(f.s)}/{N}$, where MI represents the mean index, f represents the number of ratings (i.e., 1-5) for each anti-corruption variable; s represents the score assigned to each ACM by the experts which range from 1-5 (i.e., 1= least effective to 5=most effective); and N represents the total number of responses retrieved for a specific ACM.

8.5.3 Measuring the effectiveness of the measures

Analogous to the FSE applications conducted in the previous chapters, the following steps are followed to arrive at the overall effectiveness index as well as the model for evaluating the effectiveness of anti-corruption measures:

8.5.3.1 Developing the Assessment Index System

With the establishment of six interrelated anti-corruption constructs, an evaluation index criterion is developed by defining the anti-corruption constructs as the first level index criteria. This is presented as $f_{acm} = (f_1, f_2, f_{3\ldots} f_m)$ (Ameyaw and Chan, 2015; Shao, 2004; Li et al. 2013). The measures (variables) within their respective constructs (factors) are defined as the second level index criteria $f_2 = \{f_{21}, f_{22}, f_{23\ldots} f_{2m}\}$. These established input criteria will, therefore, be used as the input variables for the analysis of the FSE technique.

8.5.3.2 Evaluating the membership functions for the AC Variables and Constructs

The membership functions of both the variables and their respective constructs of the anti-corruption measures are computed using the fuzzy mathematics and with their reference to the grading systems

employed to evaluate the effectiveness of the measures which is presented by $g = (1,2,3,4,5)$, where g_1= very low, g_2= low, g_3= neutral, g_4= high, g_5= very high. Thus, the membership functions are computed using the formula below:

$$MF_{f_{in}} = \frac{z_1 f_{in}}{g_1} + \frac{z_2 f_{in}}{g_2} + \frac{z_3 f_{in}}{g_3} + \frac{z_4 f_{in}}{g_4} + \frac{z_5 f_{in}}{g_5} = \frac{z_1 f_{in}}{very\ low} + \frac{z f_{v_{in}}}{low} + \ldots + \frac{z_5 f_{in}}{very\ high} \quad \text{equation (1)}$$

where$MF_{f_{in}}$ represents the membership function of a specific anti-corruption variable; f_{in} connotes the f_{th} anti-corruption variable of a specific construct i (i=f_1, f_2, f_3, f_4, f_5, f_6), $Z_{k\,f_{in}}$(k=1,2,3,4,5) constitutes the percentage of the experts who graded k for every specific anti-corruption measure f_{in}, which represents the degree of MF. The term $z_{1\,f_{in}}/g_1$ connotes the relation between $z_{1\,f_{in}}$ and its grade systems rather than a fraction and also '+' represents a symbol rather than an addition. Thus, given the interpretation above, equation (1) can be rewritten as $MF_{f_{in}} = (z_{1\,f_{in}} + z_{2\,f_{in}} + z_{3\,f_{in}} + z_{4\,f_{in}} + z_{5\,f_{in}})$ – equation (2). The units within every membership function range between 0 to 1 and their summation must equate 1 (i.e., $\sum_{k=1}^{5} Z_{k\,f_{in}} = 1$) – equation (3).

8.5.3.3 Determining the weightings of each ACM variable and construct

The weight function of either an ACM variable or a construct can be regarded as the relative importance of the variable/construct as estimated by the experts and from their responses. The weighted function can be determined from the normalized mean method (Lo 1999) and the analytic hierarchy process (AHP) (Hsia1998). The normalized mean method is adopted to estimate the weights of both the ACM variables and constructs for this section also as it has been identified to be straightforward, easy and has been employed by other analogous studies (Xu et al. 2010; Ameyaw and Chan 2015). The normalization of the mean values of each ACM variable and construct is calculated using the formula below:

$$y_i = \frac{M_i}{\sum_{i=1}^{5} M_i}, 0 < w_i < 1, and \sum_{i=1}^{5} w_i = 1$$

where y_i represents the weighting function of each ACM variable or construct i regarding their levels of effectiveness and M_i represent the mean index of a particular variable or construct obtained from the survey. A set's weighting function can thus be presented by; $y_i = (y_1, y_2, y_3, \ldots y_n)$ equation - (5).

8.5.3.4 Developing a multi-level and multi-criteria FSE model

The evaluation of the effectiveness of the anti-corruption measures (both at the variables' level and the construct level) is regarded as a multi-level and a multi-criteria activity encapsulating ***four*** stages. With stage one already completed (i.e., the elicitation of the experts' judgment regarding the effectiveness of the variables and the statistical computation of the measures, stage 2 comprises the establishment of both the weighting and membership functions of the anti-corruption measures (variables) based on the experts' responses from the survey. Analogous to the second stage, the third stage establishes the weighting and the membership functions at the level of the construct and then determine their respective levels of effectiveness. The last stage encapsulates all the estimated constructs and computes the overall effectiveness index, which is indicated by a single index (i.e., OEI, the overall effectiveness index).

Thus, to estimate the effectiveness of an ACM construct, a fuzzy matrix is developed for every ACM construct after the computation of the fuzzy MFs for all the variables within their constructs. Therefore, following equation 2, the MFs for all the variables within their respective constructs can be presented in the fuzzy matrix presented below:

$$R_i = \begin{vmatrix} MF_{f_{i1}} \\ MF_{f_{i2}} \\ MF_{f_{i3}} \\ \cdots \\ MF_{f_{in}} \end{vmatrix} = \begin{vmatrix} z_1{}_{f_{i1}} & z_2{}_{f_{i1}} & z_3{}_{f_{i1}} & z_4{}_{f_{i1}} & z_5{}_{f_{i1}} \\ z_2{}_{f_{i2}} & z_1{}_{f_{i2}} & z_1{}_{f_{i2}} & z_1{}_{f_{i2}} & z_1{}_{f_{i2}} \\ z_3{}_{f_{i3}} & z_1{}_{f_{i3}} & z_1{}_{f_{i3}} & z_1{}_{f_{in3}} & z_1{}_{f_{i2}} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ z_1{}_{f_{in}} & z_2{}_{f_{in}} & z_3{}_{a_{in}} & z_4{}_{a_{in}} & z_5{}_{a_{in}} \end{vmatrix}$$ – equation (6), elements are presented by $Z_{k\,f_{in}}$.

Therefore, with reference to the equation (6) and the application of the weighted function set of the ACM variables within their respective constructs, the fuzzy evaluation matrix is estimated using the formula below: $P_i = Y_i \bullet R_i$, = $(p_{in}, p_{in}, p_{in}, \dots p_{in}) \; - \; equation$ (7).

Therefore $P_i = (y_1, y_2, y_3, \dots y_n) \bullet \begin{vmatrix} z1_{f_{i1}} & z2_{f_{i1}} & z3_{f_{i1}} & z4_{f_{i1}} & z5_{f_{i1}} \\ z2_{f_{i2}} & z1_{f_{i2}} & z1_{f_{i2}} & z1_{f_{i2}} & z1_{f_{i2}} \\ z3_{f_{i3}} & z1_{f_{i3}} & z1_{f_{i3}} & z1_{f_{in3}} & z1_{f_{i2}} \\ \cdots & \cdots & \cdots & \cdots & \cdots \\ z1_{f_{in}} & z2_{f_{in}} & z3_{a_{in}} & z4_{a_{in}} & z5_{a_{in}} \end{vmatrix} = (p_{in}, p_{in}, p_{in}, \dots p_{in})$.

Where P_i represents the membership degree of the grading systems g_i, concerning a given construct i, the notation '●' represents a composite operation in the fuzzy environment. The estimated matrices $P_i \; (i = 1, 2, 3, 4, 5, 6)$ will now represent the fuzzy matrix $\bar{R}$ to estimate the

OEI of the measures (ACM). Thus $\bar{R} = \begin{vmatrix} MF_1 \\ MF_2 \\ MF_3 \\ MF_4 \\ MF_5 \\ MF_6 \end{vmatrix} = \begin{vmatrix} p_{11} & p_{12} & p_{13} & p_{14} & p_{15} \\ p_{21} & p_{22} & p_{23} & p_{24} & p_{25} \\ p_{31} & p_{32} & p_{33} & p_{34} & p_{35} \\ p_{41} & p_{42} & p_{43} & p_{44} & p_{45} \\ p_{51} & p_{52} & p_{53} & p_{54} & p_{55} \\ p_{61} & p_{62} & p_{63} & p_{65} & p_{65} \end{vmatrix}$ – equation (8).

It must be noted that the numbers presented in the set $P_i \; (i = 1, 2, 3, 4, 5, 6)$ represent the respective constructs of the ACM. Thus *1= RGM, 2= MAM, 3=COM, 4=PRM, 5=PBM, 6=REM.* Therefore, with reference to equation (7), $\bar{R}$ is again subjected to the normalization process through the weighted function of the individual constructs$(y'_1, y'_2, y'_3, \dots y'_n)$ to obtain the FSE matrix at the fourth stage as explicated in point 4, 'Developing a multi-level and multi-criteria FSE model'. Therefore,

$\bar{P} \; = \bar{Y} \bullet \bar{R} \quad \approx \quad (y'_1, y'_2, y'_3, \dots y'_n) \bullet \begin{vmatrix} p_{11} & p_{12} & p_{13} & p_{14} & p_{15} \\ p_{21} & p_{22} & p_{23} & p_{24} & p_{25} \\ p_{31} & p_{32} & p_{33} & p_{34} & p_{35} \\ p_{41} & p_{42} & p_{43} & p_{44} & p_{45} \\ p_{51} & p_{52} & p_{53} & p_{54} & p_{55} \\ p_{61} & p_{62} & p_{63} & p_{65} & p_{65} \end{vmatrix} = (P'_1, P'_2, P'_3, P'_4, P'_5) -$

equation (9).

Where $\bar{P} \; (i.e., P'_1, P'_2, P'_3, P'_4, P'_5)$ represents the membership function or the fuzzy evaluated matrix for the anti-corruption effectiveness index for the procurement, execution, and management of

infrastructure projects in the developed context, which is further captured by incorporating the grading systems (g=1, 2, 3, 4, 5). This is completed using the formula below:

$\sum_{i=1}^{5} \bar{P} \times G^t = (P'_1, P'_2, P'_3, P'_4, P'_5) \times (1,2,3,4,5), 1 \leq OEI \leq 5,$ – equation (10), where OEI represents the overall effectiveness index of ACM. This stage is normally referred to as defuzzification. The term is backed by the rationale that the fuzzy are at this level, converted into a more understandable (or 'crisp' in the fuzzy environment) to facilitate decision-making. Hence the membership functions of the ACM index are defuzzified with the application of the grading system g^t (Ameyaw and Chan 2015; Sadiq and Rodriguez 2004).

8.5.3.5 Application of the FSE technique

Applying the detailed FSE stages presented above, the FSE analysis of the data solicited from the experts to determine the effectiveness of the ACM variables and their respective constructs are presented below:

3.5.5.1. Index system development

As explicated earlier, the development of the index systems for both the constructs (first level) and the variables (second level) captured under the ACM constructs are presented as:

f_{acm}= $(f_{rgm}, f_{mam}, f_{com}, f_{prm}, f_{pbm}, f_{rem})$ representing the first level construct and;

$f_{rgm} = (f_{rgm1}, f_{rgm2}, f_{rgm3})$;

$f_{mam} = (f_{mam1}, f_{mam2}, f_{mam3}, f_{mam4}, f_{mam5})$;

$f_{com} = (f_{com1}, f_{com2}, f_{com3})$;

$f_{prm} = (f_{prm1}, f_{prm2}, f_{prm3}, f_{prm4}, f_{prm5})$;

$f_{pbm} = (f_{pbm1}, f_{pbm2}, f_{pbm3}, f_{pbm4}, f_{pbm5})$;

$f_{rem} = (f_{rem1}, f_{rem2}, f_{rem3}, f_{rem4})$ as the second level constructs.

Table 8.12: Descriptive and Weightings of ACM Variables and Constructs

No	Variables	MV	NV	SD	Sig	OR	CR	TM	WVC
	Regulatory Measures				$\boldsymbol{f_{rgm}}$			*11.15*	*0.116*
1	Comprehensive rules and regulations	3.84	0.61	0.718	f_{rgm1}	7	1		
2	Development of strong political and ethical will to enforce existing anti-corruption policies and laws.	3.76	0.52	0.786	f_{rgm2}	9	2		
3	Ethical code	3.55	0.27	0.795	f_{rgm3}	19	3		
	Managerial/Administrative Measures				$\boldsymbol{f_{mam}}$			*18.10*	*0.189*
4	Transparency mechanism	4.18	1.00	0.801	f_{mam1}	1	1		
5	Increase in accountability	3.63	0.36	0.751	f_{mam2}	15	2		
6	Financial disclosure/Disclosure	3.58	0.30	0.826	f_{mam3}	18	3		
7	Professional associations	3.39	0.09	0.855	f_{mam4}	25	4		
8	Good leadership	3.32	0.00	0.933	f_{mam5}	26	5		
	Compliance Measures				$\boldsymbol{f_{com}}$			*11.16*	*0.116*
9	Compliance to fairness and transparent procedures	3.84	0.61	0.754	f_{com1}	7	1		
10	Contractual compliance	3.79	0.55	0.811	f_{com2}	8	2		
11	Procedural compliance	3.53	0.24	0.762	f_{com3}	21	3		
	Promotional Measures				$\boldsymbol{f_{prm}}$			*21.82*	*0.227*
12	Education	3.76	0.52	0.852	f_{prm1}	10	1		
13	Training and development initiatives	3.74	0.48	0.685	f_{prm2}	11	2		
14	Raising awareness	3.74	0.48	0.828	f_{prm3}	12	3		
15	Information technology	3.61	0.33	0.823	f_{prm4}	16	4		
16	Access to information	3.55	0.27	0.860	f_{prm5}	20	5		
17	Enhance communication	3.42	0.12	0.858	f_{prm6}	24	6		
	Probing Measures				$\boldsymbol{f_{pbm}}$			*19.05*	*0.199*
18	Rigorous supervision among others	3.92	0.70	0.673	f_{pbm1}	3	1		
19	Rigorous technical auditing system	3.92	0.70	0.850	f_{pbm2}	3	2		
20	Contract monitoring	3.87	0.64	0.704	f_{pbm3}	5	3		
21	Efficient reporting system (independent hotline)	3.68	0.42	0.702	f_{pbm4}	13	4		
22	Whistle-blowing mechanism	3.66	0.39	0.669	f_{pbm5}	14	5		
	Reactive Measures				$\boldsymbol{f_{rem}}$			*14.64*	*0.153*
23	Harsh punishment	4.11	0.91	0.606	f_{rem1}	2	2		
24	Dismissal from employment	3.61	0.33	0.856	f_{rem2}	17	3		
25	Effective investigation, court proceedings, departmental disciplinary action	3.50	0.21	0.923	f_{rem3}	22	4		

26	Debarment/promoting fair debarment procedures	3.42	0.12	0.826	f_{rem4}	23	5		
								95.92	1.000

MV-Mean values; NV- Normalized values; SD-Standard Deviation; Sig-Significance; RO-Overall Rank; CR-Construct Rank; TM-Total Mean; WVC-Weighting of VC

8.5.3.6 MF assessment of the constructs and the variables

Using the gathered evaluations retrieved from the expert survey, the variable 'Training and development initiatives' obtained the following scores 0% as 'very low'; 3% as 'low'; 32% as 'moderate'; 55% as 'high' and 11% as 'very high' and was assessed through equation 1 as:

$MF_{f_{in}} = \frac{0.00}{very\ low} + \frac{0.03}{low} + \frac{0.32}{moderate} + \frac{0.55}{high} + \frac{0.11}{very\ high}$. The MF is therefore expressed through equation 2 as (0.00, 0.03, 0.32, 0.55, 0.11). The MFs for the other variables are computed in a like manner and are presented in **Table 8.13**. The generated MFs for the variables serve as the foundations for evaluating their respective constructs. However, prior to the estimations of the MFs at the construct level is the evaluation of the respective weights of the variables. The estimation of the weights is thus conducted in the next section.

8.5.3.7 Weights Estimations

The ACM variables and constructs weighted functions are computed from the mean values generated from the experts' survey. For instance, from **Table 8.12,** given the total mean of '*promotional measures'* as 19.05. Therefore, the weighted function of the variable '*efficient reporting system' (i.e., f_{pbm4})* can be calculated through equation (4) as: $y_{pbm4} = \frac{3.68}{3.92+3.92+3.87+3.68+3.66} = \frac{3.68}{19.05} = 0.193$. The remaining variables for this construct, as well as all the other constructs, are calculated following the same procedure. The results for all the weighted variables are presented in **Table 8.13.** Moreover, the individual weighted functions of a specific construct must satisfy the condition stated in equation (4) ($i.e., \sum_{i=1}^{5} y_i = 1$). Thus, using the same construct (i.e., probing measures as an example), the result of weighted function values is estimated to be, as shown below:

$\sum_{i=1}^{5} y_i = 0.206 + 0.206 + 0.203 + 0.193 + 0.192 = 1.$

The weighted functions of the constructs are also calculated using the same technique. However, instead of the variable mean values, the values for the constructs are normalized to obtain the respective weightings for each construct. Therefore, using the total means of the constructs (i.e., 95.92) and the individual means for the construct $(i.e., f_{rgm} = 11.15, f_{mam} = 18.10, f_{com} = 11.16, f_{prm} = 21.82, f_{pbm} = 19.05, f_{rem} = 14.64)$ in **Table 8.14**, the weightings for the constructs are calculated below:

$$f_{rgm} = \frac{11.15}{11.15 + 18.10 + 11.16 + 21.82 + 19.05 + 14.64} = \frac{11.15}{95.92} = 0.116$$

$$f_{mam} = \frac{18.10}{11.15 + 18.10 + 11.16 + 21.82 + 19.05 + 14.64} = \frac{18.10}{95.92} = 0.189$$

$$f_{com} = \frac{11.16}{11.15 + 18.10 + 11.16 + 21.82 + 19.05 + 14.64} = \frac{11.16}{95.92} = 0.116$$

$$f_{prm} = \frac{21.82}{11.15 + 18.10 + 11.16 + 21.82 + 19.05 + 14.64} = \frac{21.82}{95.92} = 0.227$$

$$f_{pbm} = \frac{19.05}{11.15 + 18.10 + 11.16 + 21.82 + 19.05 + 14.64} = \frac{19.05}{95.92} = 0.199$$

$$f_{rem} = \frac{14.64}{11.15 + 18.10 + 11.16 + 21.82 + 19.05 + 14.64} = \frac{14.64}{95.92} = 0.153$$

Analogous to the estimations of the weighted functions of the variables, the normalized weightings of the constructs must sum up to 1 $(i.e., \sum_{i=1}^{5} y_i = 0.116 + 0.189 + 0.116 + 0.227 + 0.199 + 0.153 = 1)$. The estimated values are moreover presented through equation 5 as:

$y_i = (0.116, 0.189, 0.116, 0.227, 0.199, 0.153)$.

Table 8.13: Membership Functions (MFs) at ACM Variables and Constructs Levels

No	Variables	Mean	Weightings	MF for Level 3	MF for Level 2
	Regulatory Measures (f_{rgm})				0.02, 0.04, 0.26, 0.58, 0.11
1	f_{rgm1}	3.84	0.344	0.00, 0.05, 0.18, 0.63, 0.13	
2	f_{rgm2}	3.76	0.337	0.03, 0.03, 0.21, 0.63, 0.11	
3	f_{rgm3}	3.55	0.318	0.03, 0.03, 0.39, 0.47, 0.08	

	Managerial Measures (f_{mam})				0.01, 0.06, 0.35, 0.40, 0.17
4	f_{mam1}	4.18	0.231	0.00, 0.03, 0.16, 0.42, 0.39	
5	f_{mam2}	3.63	0.201	0.00, 0.05, 0.37, 0.47, 0.11	
6	f_{mam3}	3.58	0.198	0.03, 0.03, 0.39, 0.45, 0.11	
7	f_{mam4}	3.39	0.187	0.03, 0.08, 0.45, 0.37, 0.08	
8	f_{mam5}	3.32	0.183	0.03, 0.13, 0.45, 0.29, 0.11	
	Compliance Measures (f_{com})				0.01, 0.03, 0.35, 0.47, 0.15
9	f_{com1}	3.84	0.344	0.00, 0.03, 0.29, 0.50, 0.18	
10	f_{com2}	3.79	0.340	0.03, 0.00, 0.29, 0.53, 0.16	
11	f_{com3}	3.53	0.316	0.00, 0.05, 0.47, 0.37, 0.11	
	Promotional Measures (f_{prm})				0.02, 0.05, 0.29, 0.53, 0.10
12	f_{prm1}	3.76	0.172	0.03, 0.03, 0.26, 0.53, 0.16	
13	f_{prm2}	3.74	0.171	0.00, 0.03, 0.32, 0.55, 0.11	
14	f_{prm3}	3.74	0.171	0.03, 0.03, 0.26, 0.55, 0.13	
15	f_{prm4}	3.61	0.165	0.03, 0.05, 0.29, 0.55, 0.08	
16	f_{prm5}	3.55	0.163	0.03, 0.05, 0.37, 0.45, 0.11	
17	f_{prm6}	3.42	0.157	0.03, 0.13, 0.26, 0.55, 0.03	
	Probing Measures (f_{pbm})				0.01, 0.02, 0.24, 0.59, 0.13
18	f_{pbm1}	3.92	0.206	0.00, 0.03, 0.18, 0.63, 0.16	
19	f_{pbm2}	3.92	0.206	0.03, 0.03, 0.16, 0.58, 0.21	
20	f_{pbm3}	3.87	0.203	0.03, 0.00, 0.16, 0.71, 0.11	
21	f_{pbm4}	3.68	0.193	0.00, 0.03, 0.37, 0.50, 0.11	
22	f_{pbm5}	3.66	0.192	0.00, 0.03, 0.37, 0.53, 0.08	
	Reactive Measures (f_{rem})				0.02, 0.06, 0.26, 0.53, 0.12
23	f_{rem1}	4.11	0.281	0.00, 0.00, 0.13, 0.63, 0.24	
24	f_{rem2}	3.61	0.247	0.03, 0.08, 0.24, 0.58, 0.08	
25	f_{rem3}	3.50	0.239	0.03, 0.13, 0.24, 0.53, 0.08	
26	f_{rem4}	3.42	0.234	0.03, 0.05, 0.47, 0.37, 0.08	

8.5.3.8 Multi-level and multi-criteria FSE model Development

As stated earlier, the FSE technique encapsulates three levels (i.e., from level three to level one). To determine the effectiveness of a particular ACM variable, the membership function (or the fuzzy relational matrix) is first computed based on the responses obtained from the experts as established previously. This is succeeded by the derivation of the MFs at the construct level. Thus, the equations 6 and 7 are employed to generate the MFs at both levels. For instance, the MFs of the variables within the managerial/administrative construct $(i.e., f_{mam1})$ can be presented as:

$$R_{mam} = \begin{vmatrix} MF_{f_{mam1}} \\ MF_{f_{mam2}} \\ MF_{f_{mam3}} \\ MF_{f_{mam4}} \\ MF_{f_{mam5}} \end{vmatrix} = \begin{vmatrix} 0.00 & 0.03 & 0.16 & 0.42 & 0.39 \\ 0.00 & 0.05 & 0.37 & 0.47 & 0.11 \\ 0.03 & 0.03 & 0.39 & 0.45 & 0.11 \\ 0.03 & 0.08 & 0.45 & 0.37 & 0.08 \\ 0.03 & 0.13 & 0.45 & 0.29 & 0.11 \end{vmatrix}$$ The MF (fuzzy matrix) generated at this point

is further normalized through the weighted functions of the variables within their respective construct (f_{mam}) to generate the evaluation matrix. This is computed using the equation as presented below:

$$P_i = Y_i \bullet R_i, = (p_{in}, p_{in}, p_{in}, \dots p_{in}) \approx (y_{mam1}, y_{mam2}, y_{mam3}, y_{mam4}, y_{mam5})\ x \begin{vmatrix} MF_{f_{mam1}} \\ MF_{f_{mam2}} \\ MF_{f_{mam3}} \\ MF_{f_{mam4}} \\ MF_{f_{mam5}} \end{vmatrix}$$

$$P_i = (0.231, 0.201, 0.198, 0.187, 0.183)\ x \begin{vmatrix} 0.00 & 0.03 & 0.16 & 0.42 & 0.39 \\ 0.00 & 0.05 & 0.37 & 0.47 & 0.11 \\ 0.03 & 0.03 & 0.39 & 0.45 & 0.11 \\ 0.03 & 0.08 & 0.45 & 0.37 & 0.08 \\ 0.03 & 0.13 & 0.45 & 0.29 & 0.11 \end{vmatrix}$$. Therefore,

$P_i = (0.01, 0.06, 0.35, 0.40, 0.17)$. The fuzzy evaluation matrix for the remaining constructs are generated following the same technique. Therefore, having established the variables of the ACM, the effectiveness of the constructs can be determined using equation (10) $(i.e., \sum_{i=1}^{5} \bar{P} \times G^t)\ 1 \leq OEI \leq 5$ as demonstrated below:

$$\sum_{i=1}^{5} P_{mam} \times G^t = (0.01, 0.06, 0.35, 0.40, 0.17) \times (1,2,3,4,5)$$

$EI_{mam} = [(0.01 \times 1) + (0.06 \times 2) + (0.35 \times 3) + (0.40 \times 4) + (0.17 \times 5)] = 3.65$ (effective)

Where EI represents the effectiveness index (EI) for the construct. The remaining constructs are thus, computed using the same formula as presented below:

$EI_{rgm} = [(0.02 \times 1) + (0.04 \times 2) + (0.26 \times 3) + (0.58 \times 4) + (0.11 \times 5)] = 3.72$ (effective)

$EI_{com} = [(0.01 \times 1) + (0.03 \times 2) + (0.35 \times 3) + (0.47 \times 4) + (0.15 \times 5)] = 3.72$ (effective)

$EI_{prm} = [(0.02 \times 1) + (0.05 \times 2) + (0.29 \times 3) + (0.53 \times 4) + (0.10 \times 5)] = 3.64$ (effective)

$EI_{pbm} = [(0.01 \times 1) + (0.02 \times 2) + (0.24 \times 3) + (0.59 \times 4) + (0.13 \times 5)] = 3.81$ (effective)

$EI_{rem} = [(0.02 \times 1) + (0.06 \times 2) + (0.26 \times 3) + (0.53 \times 4) + (0.12 \times 5)] = 3.68$ (effective)

8.5.3.9 Assessment of the Overall Effectiveness Index (OEI)

Following the formula indicated in the equation (9) ($i.e., \bar{P} = \bar{Y} \bullet \bar{R}$), the fuzzy matrix obtained at this level $[i.e., P_i\ (i = f_{rgm}, f_{mam}, f_{com}, f_{prm}, f_{pbm}, f_{rem})]$ regarding the constructs of the ACM are further normalized through the weighted functions to compute for the ultimate fuzzy evaluation matrix of the overall effectiveness index of the anti-corruption measures. The individual MFs of the constructs forming the fuzzy matrix are presented in **Table 8.14** (fourth column).

Table 8.14: Membership Functions (MFs) at ACM Level 2 and 1

No	ACM Constructs	Weighting	MF for Level 2	MF for Level 1
1	Regulatory Measures	0.116	0.02,0.04, 0.26, 0.58, 0.11	0.02, 0.04, 0.29, 0.52, 0.13
2	Managerial Measures	0.189	0.01, 0.06, 0.35, 0.40, 0.17	
3	Compliance Measures	0.116	0.01, 0.03, 0.35, 0.47, 0.15	
4	Promotional Measures	0.227	0.02, 0.05, 0.29, 0.53, 0.10	
5	Probing Measures	0.199	0.01, 0.02, 0.24, 0.59, 0.13	
6	Reactive Measures	0.153	0.02, 0.06, 0.26, 0.53, 0.12	

$$\bar{R}_{(oei)} = \begin{vmatrix} P_{f_{rgm}} \\ P_{f_{mam}} \\ P_{f_{com}} \\ P_{f_{prm}} \\ P_{f_{pbm}} \\ P_{f_{rem}} \end{vmatrix} = \begin{vmatrix} 0.02 & 0.04 & 0.26 & 0.58 & 0.11 \\ 0.01 & 0.06 & 0.35 & 0.40 & 0.17 \\ 0.01 & 0.03 & 0.35 & 0.47 & 0.15 \\ 0.02 & 0.05 & 0.29 & 0.53 & 0.10 \\ 0.01 & 0.02 & 0.24 & 0.59 & 0.13 \\ 0.02 & 0.06 & 0.26 & 0.53 & 0.12 \end{vmatrix}$$

Moreover, given the weighted functions of the constructs as $\bar{Y}$ = (0.116, 0.189, 0.116, 0.227, 0.199, 0.153), the overall ACM effectiveness of the final evaluation matrix is computed through equation (9) as presented below:

$$\bar{P}_{(oei)} = \bar{Y}_{(oei)} \bullet \bar{R}_{(oei)} \approx \begin{vmatrix} 0.116 \\ 0.189 \\ 0.116 \\ 0.227 \\ 0.199 \\ 0.153 \end{vmatrix} \times \begin{vmatrix} 0.02 & 0.04 & 0.26 & 0.58 & 0.11 \\ 0.01 & 0.06 & 0.35 & 0.40 & 0.17 \\ 0.01 & 0.03 & 0.35 & 0.47 & 0.15 \\ 0.02 & 0.05 & 0.29 & 0.53 & 0.10 \\ 0.01 & 0.02 & 0.24 & 0.59 & 0.13 \\ 0.02 & 0.06 & 0.26 & 0.53 & 0.12 \end{vmatrix} =$$

$(0.02, 0.04, 0.29, 0.52, 0.13)$

Lastly, the overall effectiveness index of ACM employed to extirpate the proliferation of corrupt practices in both the procurement and management of infrastructure works in the context of HK are presented below:

$ACM_{oei} = [(0.02 \times 1) + (0.04 \times 2) + (0.29 \times 3) + (0.52 \times 4) + (0.13 \times 5)] = 3.70$ *(effective).*

8.5.4 Discussions

Thee individual variables formed the basis to estimate the effectiveness index (EI) for the constructs, which are as well computer to arrive at the overall effectiveness index. Per the results from the survey, the overall effectiveness index generated from the fuzzy synthetic evaluation technique was 3.70, which indicates that anti-corruption measures stipulated to guide the procurement, execution, management, and realization of infrastructure projects are generally effective. The succeeding sections detail the performance of the individual anti-corruption measures and their contributions towards the respective constructs. The constructs are presented in order of their thematic underpinnings guided by the ICAC's three-pronged approach. They are prevention, education, and enforcement (ICAC, 2018). **Fig. 8.8**,

therefore, presents a summary of the thematic representations of the ACM constructs based on the ICAC model.

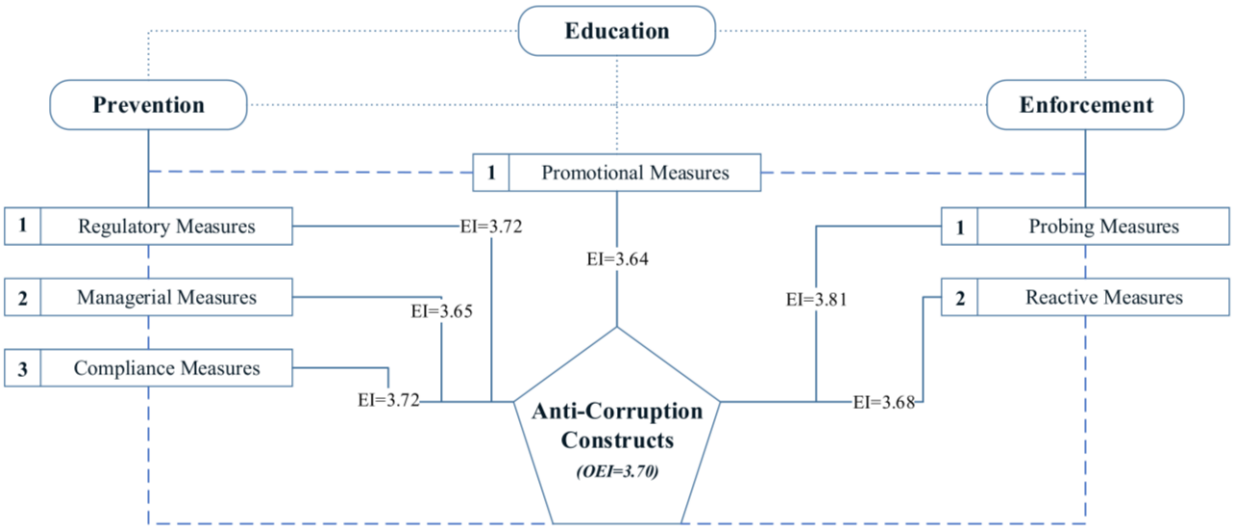


Figure 8.8: Thematic representation of ACM constructs

8.5.4.1 Overview of Hong Kong's Anti-Corruption Institution

The Independent Commission Against Corruption (ICAC) of HK is the institution responsible for enforcing and ensuring the effectiveness of anti-corruption measures in Hong Kong (ICAC 2018; Gong et al. 2015). The institution is made up of 3 effective divisions is with unique responsibilities. They are: 1) the operations department which constitutes the investigative branch of the institution (that is, responsible for conducting investigations right from when cases are received to the closing of cases); 2) the corruption prevention department, responsible for examining the actions and procedures of public institutions and government departments to safeguard any activity that may be susceptible to the incidence of corruption and lastly 3) the community relations department responsible for educating the general public against the incidence and the woes of corrupt practices. With the functionality of the departments carefully delineated, the efficacy of the three-pronged approach encompassed within the three respective departments (that is, law enforcement, prevention, and education) is always on the ascendancy. The section of the study explicates the results of the anti-corruption constructs based on the thematic underpinnings of the three-pronged approach by the three departments of ICAC.

8.5.4.2 Corruption Prevention

The constructs captured under this theme encapsulates regulatory measures (RGM), managerial measures, and compliance measures. RGM was identified to be the second leading construct with an effectiveness index of 3.72. Also, all the individual variables were revealed to be effective, per the responses of the experts. The individual measures that make up the RGM construct are: comprehensive rules and regulations with an EI of 3.84, development of strong political and ethical will to enforce existing anti-corruption laws and policies (Powell 2006; Shakantu 2006) with a mean value of 3.76, and the development and enforcement of ethical codes to guide the procurement execution and management of infrastructure projects (Tabish and Jha 2012; Sohail and Cavil 2006) with a mean value of 3.55.

Per the definition of regulatory measures which connotes statutory measures (i.e., acts, decrees and laws), as well as regulation, it is stipulated to guide public institutions in order to limit the proliferation of corrupt acts as well as public parties and project parties from getting involved in corrupt acts (Owusu et al. 2018). The RGM construct is technically and thematically observed to be skewed towards the stipulations of the corruption prevention department CPD (ICAC 2018). According to Owusu et al. (2019), preventive measures, which are as well regarded as proactive measures enforced to prevent corrupt acts from happening typically in the procurement and management of infrastructure projects, should be structured to prevent the incidents of corruption. Also, it is needed to create an atmosphere of a corrupt-free environment that encourages the right thing to be done even when exposed to corruption.

Managerial Measures The next preventive construct that succeeds both the regulatory and Compliance measures is the managerial construct. As the heading implies, the managerial measures are defined to be proactive administrative measures stipulated to effectively guide in the modus operandi of the internal structures of public departments or private sector towards the prevention and extirpation of corrupt practices (Owusu et al. 2018). Per the analysis conducted, the construct was ranked fourth with an overall effectiveness index of 3.65. However, unlike the preceding constructs discussed, the

managerial construct encapsulates five variables of which three are regarded effective, and the remaining two identified to be moderately effective. The first three effective measures are transparency mechanism with Eileen index of 4.18, increase in institutional accountability with a main index of 3.63, and ensuring the disclosure of vital information that a house is transparency, such as financial disclosure with a mean index of 3.58. Among these variables, transparency mechanism was not only realized as the leading variable within this construct but also among the total twenty-six anti-corruption measures analyzed. The Assurance of transparency in public projects as well as within the public department has been recognized as one of the key strongholds of any society or institution that is less prone to the incidences of corrupt practices (Boyd and Padilla 2009; Ling et al. 2014).

For instance, according to the study of Kenny (2012), the incessant exposure of contractual and implementation details was identified to be part of the key means of enhancing project transparency. Similar to the transparency mechanism, the remaining two effective measures (i.e., increase in accountability as well as the disclosure of relevant information such as financial standings and all relevant tender information to potential bidders among others) are geared towards creating an atmosphere of transparency, thus limiting the manifestation and proliferation of corrupt acts (Bowen et al. 2012; Tabish and Jha 2011). Even though good leadership and professional associations were identified to be moderately effective, other managerial structures stipulated to limit the incidence of corrupt practices may include strengthening of professional bodies and creating a system of checks and balances. That is, creating an environment where the works of each department in the public sector domain or the private institutions could be checked during the expending and executing of their respective departmental duties (Zou 2006; Brown and Loosemore 2015).

Compliance Measures Compliance measures, on the other hand, are stipulated to either encourage the adherence to contractual requirements and regulations binding a project. As a preventive tool, the aim of compliance measures seeks to obtain either full adherence or concordance as well as limit the attitude of non-compliance, less compliance, or even partial compliance (Worthy et al. 2017). Also, with an effectiveness index of 3.72, similar to that of regulatory measures, the variables captured under these

constructs were identified to be effective. They include stipulations such as compliance to fairness and transparent procedures, with a mean value of 3.84, compliance to contractual requirements with a mean value of 3.79, and the compliance to procedural stipulations being the least but effective variable with a mean value of 3.53. According to Owusu et al. (2018), other measures captured under this construct include compliance to code of conduct as well as professional standards which are protected with other reactive measures discuss later in this section (Powell 2006; Sohail and Cavill 2008; de Jong et al. 2009). According to TI (2018), one of the primary factors that differentiate corrupt cities and societies from less corrupt societies hangs on the drive of parties to adhere to stipulations laws and regulations. For instance, according to Le et al. (2014), flawed regulation system contributes heavily to the causal instigators of corruption in the Chinese infrastructure projects. This evolves as a result of non-adherence to their stipulated laws and regulations. Similar cases are reported in developing countries, including India (Tabish and Jha 2012) Zambia (Sichombo et al. 2009) and Ghana (Ameyaw et al. 2017) among other developing countries.

Contrastingly, in developed cities such as HK, the respondents are of the view that HK has attained an appreciable level of cleanliness regarding the level of corruption in the city as a result of effective compliance measures. Owusu et al. (2018) reported that it is one thing to develop and enforce ACMs, and it is another thing to ensure concordance from the side of the parties to which the laws and regulations affect. The needed input from both scholars and industrial practitioners would be to strategize effective means of creating working environments that ensure full compliance.

8.5.4.3 Education

Promotional Measures (PRM) was the lone construct captured under this theme. The PRM construct was the least ranked construct among the six constructs under investigation. Promotional measures are classified as publicity mechanisms employed to propagate and extend the knowledge and information on corruption (that is, their occurrence, consequences, and resolute measures) to a specific class of people or the general public (Owusu et al. 2018). In effect, they are stipulated to inform the recipient of the information, especially in the public domain about proactive measures (I.e., managerial,

compliance and probing measures) and their effect on work processes as well as their influence on the public institutions. With an overall construct EI of 3.64, the promotional construct was as well identified to be effective within the context of Hong Kong procurement processes. There are six variables captured under this construct, which makes it the construct with most measures. The variables captured under the promotional measures construct were: 1) education, which was ranked first with an MI of 3.76, training and development initiatives as well as raising awareness each with equal MI of 3.74, the use of information technology not only to enhance transparency through e-government and e-procurement but also to publicize information on corruption and encourage whistleblowing mechanism as it is one of the platforms for submitting complaints (Stansbury 2009; Søreide 2002; Ameyaw et al. 2017; Neupane 2014).

The use of Information technology was ranked fourth under this contract with an EI of 3.61 and the remaining two, which are access to information and enhance communication coming fifth and sixth position with respective me indexes of 3.55 and 3.42. Therefore, among all the six measures, the only variable that needs effort in addressing to make it more effective is the communication enhancement. Whether between departments of public sectors, parties associated with a project or publicizing stipulated proactive and reactive measures to the general public. For instance, in HK, the Department of community relations of the ICAC that's responsible for executing promotional measures, especially in the form of public education, raising awareness and conducting periodic training to keep the information on corruption well spread.

According to the institution, the department is responsible for encouraging the adoption of an "ethics for all" attitude to relay tailor-made and context-oriented proactive educational programs for different target groups to advance the integration of personal contact and media publicity among other effective strategies. As opined in the previous section about the importance of reactive measures, equal attention is needed to advance the course of promotional measures. Moreover, per the study of Owusu et al. (2019), the development and enforcement of anti-corruption frameworks without careful consideration

on how to adequately publicize, educate, raise awareness and conduct periodic training to keep informants up to date may limit the enforced measures from experiencing their full potency.

8.5.4.4 Enforcement

Two constructs were captured under this theme. They are: 1) probing measures and 2) reactive measures. To probe simply means to search into, examine, or investigate (Cambridge Dictionary 2018). The probing construct, also termed as the investigative construct are stipulated to ensure effective investigations and also monitor the processes involved in infrastructure procurement to deter project parties from engaging in corrupt acts (Suen et al. 2007; Ameyaw et al. 2017). This construct was however, identified to be the most effective category amount the six constructs with an EI of 3.81. In descending order of effectiveness, the measures captured under this contract include conducting regular supervision and technical auditing from time to time with equal mean indexes of 3.92 (Zhang et al. 2016; Søreide 2002); monitoring of contract (Sohail and Cavil 2006; Kenny 2012), setting up an efficient reporting system and whistleblowing mechanisms with your respective mean indexes of 3.87, 2.68, and 3.66.

As the most effective anti-corruption construct, the modus operandi of the probing techniques determines how successful a suspected corruption case may turn out (Wai 2006). The ICAC of Hong Kong has indicated the importance of the investigation processes. Thus, it follows a very stringent procedure every reported case goes through right from when the case is reported through to its closure. According to Wai (2006), even though similar importance is placed on all three-pronged measures (i.e., deterrence prevention and education), greater emphasis is placed on 'deterrence' that is, the main activity of the operations department. The evidence is seen in the devotion of over 70% of ICACs resources channeled to the operations department. This perhaps demonstrates how the respondents see the variables within the probing constructs to be the most effective measures, among others.

Reactive Measures was revealed to be the fifth most relevant anti-corruption construct with an overall construct EI of 3.68, indicating the effectiveness of the construct. Unlike proactive measures, reactive measures are control mechanisms stipulated to render Justice to offenders all corrupt parties and deter

them from subsequent involvement in a corrupt act (Owusu et al. 2018). Therefore, at any given moment where proactive measures are infringed upon, there is the need to apply reactive measures to ensure an incessant atmosphere of a corrupt-free environment. The construct encapsulate measures which are; 1) offering harsh punishment to culprits (with an MI of 4.11 being the most effective variable under this construct and the second most effective among the overall 26 measures); 2) dismissal from unemployment in other disciplinary action (with an MI of 3.61) which may not be regarded as a harsh punishment such as life imprisonment depending on the case at hand and the act of promoting debarment procedures (Stansbury 2009; Ameyaw et al. 2017).

A typical instance of rendering a debarment procedure may occur in the case of the procurement process, where certain builders are exempted from submitting tenders due to previous cases of involvement in corrupt acts. Debarment procedures are effective reactive tools that are set to deter parties from corrupt at knowing that there is a higher consequence of being exempted from future opportunities (Williams 2007). Again, per the departmental obligations of the ICAC, the operations department is solely responsible for rendering reactive measures and charges mentioned earlier. According to the study of Owusu et al. (2018), no matter how active and effective proactive and promotional measures are, the absence of stringent and effective reactive measures has the capacity to reader institutions and processes to the susceptibility of corrupt acts. Therefore, similar to the relevance of both promotional and managerial measures, the importance of this construct demonstrates the interconnectedness of the constructs developed. Thus, one construct cannot fully stand without engaging the full potency another. Lastly, reactive measures are known to send a strong deterring message if rendered to corrupt public officials.

8.5.5 Concluding remarks

This section of the study examined the effectiveness of anti-corruption measures in the developed contest using the FSE technique. The purposive sampling approach was adopted to arrive at 38 experts involved in the procurement and management processes of infrastructure projects. The experts were

requested to evaluate the effectiveness of 26 unique anti-corruption measures categorized under the constructs namely probing measures, regulatory measures, compliance measures, managerial measures, reactive measures, and promotional measures (Owusu et al. 2018).

Per the results obtained from the application of the FSE technique, the overall effectiveness Index of anti-corruption measures generated was 3.70, which indicates that anti-corruption measures guiding the procurement, execution, and management of infrastructure works in the developed regions (particularly in HK) are generally effective. Moreover, all the six constructs captured in this section were as well identified to be effective with their respective mean values ranging from 3.81 (i.e., probing measures, being the highest ranked variable) to 3.64 (promotional measures obtaining the lowest index even though noted as effective). Regarding the effectiveness of the individual variables, the top five measures that were identified to be effective were transparency mechanism, harsh punishment, rigorous supervision, and technical auditing and, monitoring contractual performance.

Moreover, the six categories were further structured under the three-pronged approach developed by HK to tackle corruption as well as the three departments responsible for executing the respective tasks based on the thematic underpinnings of the constructs. This three-pronged approach has been identified not only in scholarly works but also in international reports as one of the most successful anti-corruption models in the world presently. They are deterrence, prevention, and education. Therefore, whereas probing and reactive measures were identified to be functions associated with the operations department (deterrence), promotional areas were identified to be related functions of the community relations department (education). Lastly, the remaining three constructs, namely, regulatory, compliance, and administrative measures, were captured under the functions of the corruption prevention department (prevention). As a successful model, it is noted that even though these departments stem from one unit, (that is, the ICAC) they are however structured in the format where the functions are executed 'department-wise' and to their full effect to enhance transparency and limit the proliferation of corrupt acts. Moreover, as an exemplary model, the departmentalization of the six constructs captured in this section of the study may inform other corrupt institutions and countries on how to strategically enforce

the variables captured under the constructs by the required specialties (i.e., by their respective division of labor).

8.6 Chapter Summary

Following the empirical examination of the negative constructs this chapter conducted a comparative examination of the constructs of corruption, particularly focusing on the effectiveness of anti-corruption measures and the negative factors that hamper the effectiveness of anti-corruption measures. This comparative analysis was concluded to determine the contextual disparities between the developed and developing contexts given the general notion that anti-corruption stipulations in the developed context are more effective as compared to that of the developing countries. Thus, this chapter first tested the validity of the established supposition and also tested for the effectiveness of the individual variables against the negative constructs of corruption. After realizing that most of the variables were either neutrally effective or less effective, a common theme that emerged from further exploration encapsulated the barriers (i.e., factors) that hampered the effectiveness of anti-corruption. As a result, the variables captured under this construct were examined to ascertain their individual criticalities and their relational impacts on the effectiveness of anti-corruption measures. Following the examination of all the variables in relation to the procurement process, a further assessment of the effectiveness of the anti-corruption measures was conducted, specifically using Hong Kong as an exemplary case model. All the constructs were examined within the context of Hong Kong and were identified to be effective justifying the selection of HK as an exemplary context for other countries can learn from.

CHAPTER 9 – DEVELOPING THE DYNAMIC FRAMEWORK [15]

9.1 Introduction

This section examines the impacts of the negative constructs of corruption on the procurement process of infrastructure projects. In all cases, the criticalities of the variables encapsulated within the negative constructs were examined in relation to their impacts on the procurement process. Eleven activities within the procurement process were revealed to have been significantly impacted by overarching variables of the negative constructs. However, only seven activities were noted in the case of the forms. The results reveal the dynamic nature of the variables that instigates corruption within the procurement process. Thus, given the dynamic nature of the variables captured under the negative constructs coupled with the high complexities of the procurement process, this study further examined these two critical issues regarding corruption within the procurement process.

This section contributes to the scholarship on understanding the dynamism of the constructs of corruption and their impacts on the complex process of infrastructure procurement. Moreover, the developed dynamic model contributes significantly not only to facilitate the decision-making process regarding policies but also offers an in-depth understanding on the relational interactions of the constructs of corruption and how they can be mitigated, and the established anti-corruption measures enforced. Practically, it provides valuable information on how to dynamically mitigate or extirpate the criticalities associated with the negative constructs of corruption and improve the efficacy of anti-corruption measures.

[15] This chapter is fully or partially published in the following journal article: Owusu, E.K., Chan A.P.C. (2020). Extirpating Corruption in Urban Infrastructure Procurement: The Dynamic Criticalities and the Way Forward. *Cities* (Manuscript ID: JCIT_2019_1839

9.1.1 SD Model development - A 'corrupt free' procurement SD model

System Dynamics was first introduced by Forrester in 1958 using computer simulation and feedback control theory to facilitate the quantitative analysis or simulations of complex structures or systems. System Dynamics has been widely used as a multidisciplinary simulation tool in project management, business, decision sciences, and construction management domains, among others. It is often employed to analyze the Dynamics and complexities associated with projects (Khan et al. 2016). However, its applicability to analyze corruption in projects has been recommended but rarely conducted or used. As a standardized simulation tool, the SD is noted to facilitate the management of complex processes that rely on feedback, communication, and the receipt of information (Ding et al. 2016).

Thus, the modeling process is highly dependable on the interactions among the variables captured in the process. SD examines the holistic perspective of a system focusing on the given elements, construct or the measurement items of that particular system at a time. Thus, it enables the examination of the relational attributes between the components of a system and their behavior over time. Moreover, in research, SD has been adapted to examine different topics ranging from productivity rework, construction demolition, safety culture, and forensic project management, among others (Li et al. 2014). The SD methodology is used in this study to examine the complexities of the procurement process and the dynamism of the indicators of corruption. Thus, the application of the SD methodology in this study is intended to facilitate the understanding of how the procurement process responds to the interactions and the changes or the dynamic behavior of the negative constructs of corruption. Moreover, it is employed to explicate the behavior of the procurement system under suggested propositions of the anti-corruption strategies stipulated to mitigate corrupt practices within the procurement process. The SD

modeling approach, therefore, helps to evaluate the relational feedback and the consequences of new structures and new policies (Wang et al. 2018). Given the SD's ability to evaluate the complexities associated with the procurement process and the dynamism of the variables of the constructs, it was considered the most suitable approach in conjunction with the network analysis approach to fulfill the aim and the objectives underpinning this study. Aside from the network assessment of the impacts of the negative constructs of corruption on the procurement process, this study develops an SD model to facilitate the decision-making process on how the incidences and effects of corruption can be mitigated and extirpated at the various stages of the procurement process.

At the same time, the model is intended to facilitate the enhancement of the effectiveness of anti-corruption measures. The developed model can, therefore, reflect the quantitative demonstration of the feedback between the activities noted under the procurement process and the measurement items captured under the negative constructs of corrupt practices. While the SD methodology has wide contexts of application, it is employed in this study to examine the behavior of the procurement system under the influence of the dynamics of the negative constructs of corruption as well as that of the ACMs.

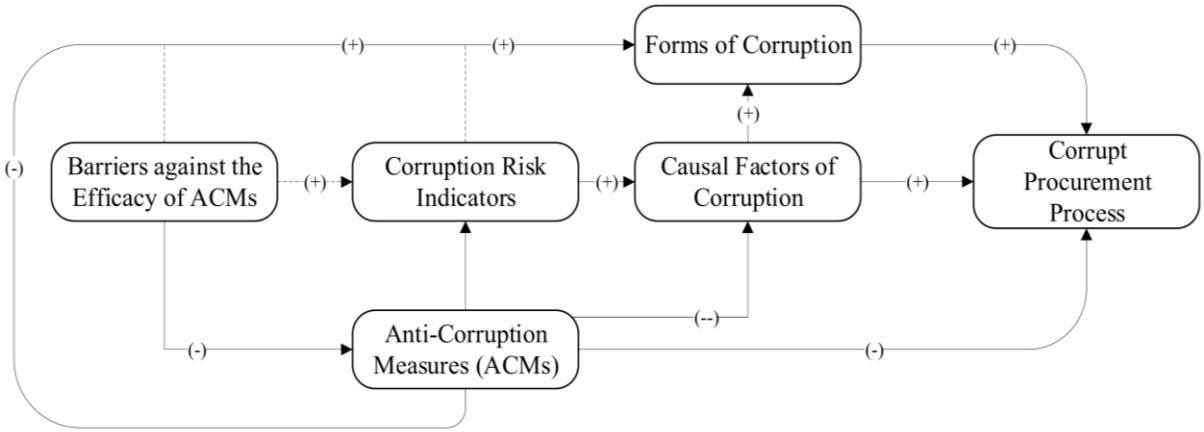


Figure 9.1: Theoretical relationships among the constructs Conceptual Framework

9.1.2 Causal Loop Diagram (CLD) and conceptual model formulation

Corruption extirpation in this study is measured in two directions. They are: 1) reducing the incidence and the impacts of the significant negative constructs of corruption practices and 2) increase the effectiveness of the extant ACMs stipulated to check corruption within the procurement process. Thus, the development of both the initial models are intended to reveal the significant variables captured under 1) the causal factors of corruption; 2) the irregularities or risk indicators of corruption; 3) the effectiveness of anti-corruption measures and 4) the barriers that hamper the efficacy of anti-corruption measures. Thus, apart from the construct of the ACM, the remaining constructs highlight the negative constructs of corruption. As a result, two distinct constructs are discussed. Thus, the two loops considered here are 1) the positive indicator (+) where the constructs of corruption are noted to contribute or add to the incidence and accumulated impact of corruption and 2) the negative indicator (-) where the variables of anti-corruption measures are noted to repeal the impacts and effects of corruption. Simply put, the ACM construct, and its underlying variables contribute negatively to the accumulated impact of corruption.

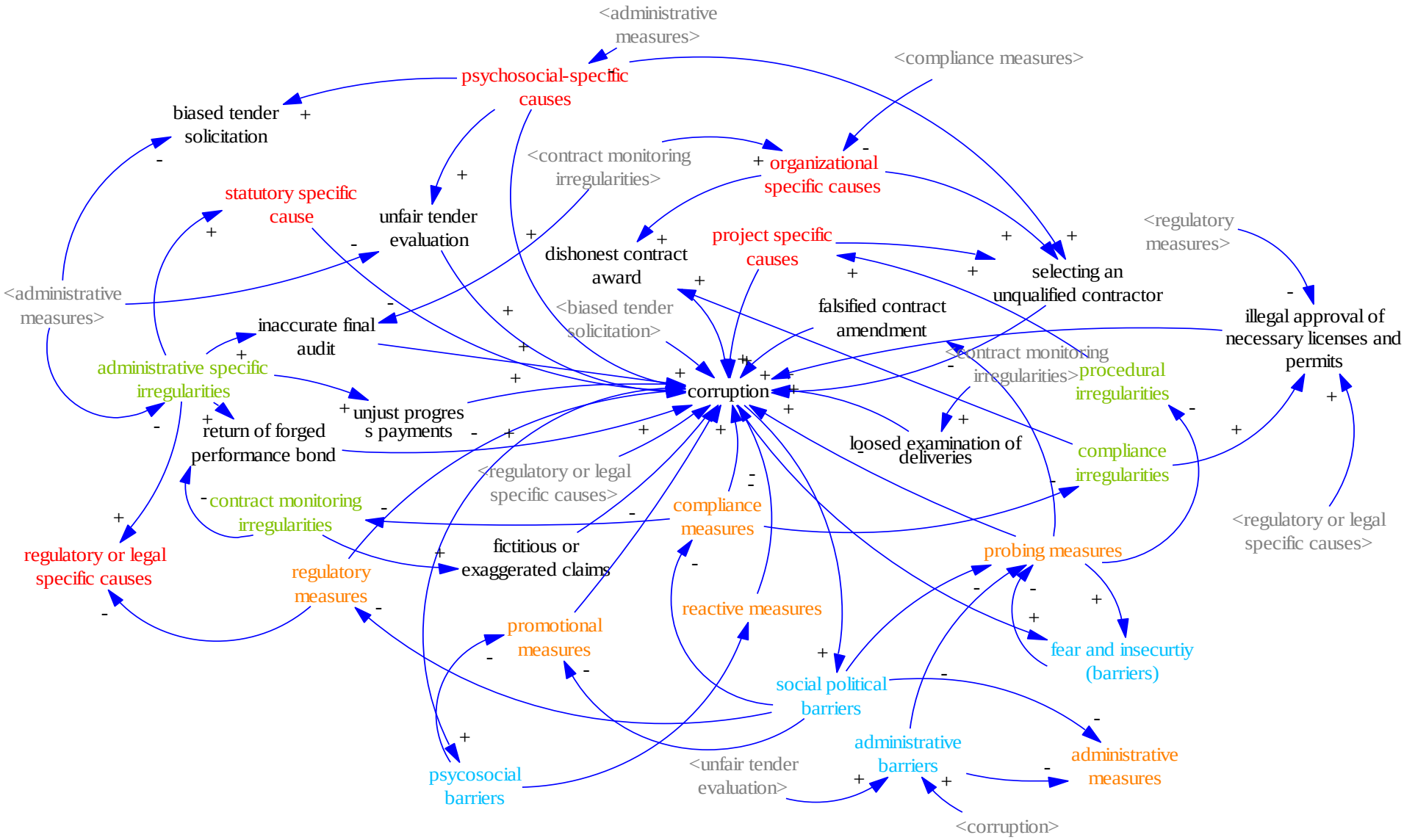


Figure 9.2: Causal Loop Diagram (CLD) of the constructs of corruption and the procurement process activities

The positive loop commences with the contextual risk indicators of corruption. As highlighted earlier, these risk indicators are not necessarily primary instigators of the causal factors of corruption but rather they are context-specific threats that pose the potency of contributing to the causal factors of corruption with time (Le et al. 2014a; Owusu et al. 2019). Thus, if left unchecked, they may contribute to the factors that cause corruption in the given context. For instance, one of the critical contextual risk indicators identified in this study was the likelihood of procurement board members not adhering to the stipulations of the procurement act. Given the definition of the risk indicators and the causal factors of corruption, not following the established act may not necessarily be induced by or underpinned by the possibility of the board members corrupting the process. The action may be influenced by other factors other than corruption. Thus, given the scenario above, the risk indicator mentioned may not directly contribute to the incidence of corruption. However, depending on the criticality and the time frame allowed for this risk to thrive without immediate application of the necessary corrective measures, this risk indicator may create enough room for any related causal factor of corruption to be incubated and lead to or allow corruption to occur with time.

Thus, in the design of the causal loop diagram, the first-hand construct of consideration are the contextual risk indicators, which influence the incidence and criticalities of the causal factors of corruption. The first relationship established is that of the risk indicators leading to the causal factors of corruption (Le et al. 2014; Owusu et al. 2019). The causal factors (otherwise known as the causes of corruption) are considered as the main instigators or direct propellers of corruption in the given context (Zhang et al. 2016; Zou 2006). As a result, while the risk indicators are considered to have a direct positive influence on the causal factors, the causal factors, in turn, contribute to the main incidence of

corruption within the different activities of the procurement process. However, as the causal factors continue to contribute to the accumulated level of corruption in a given context, there are anti-corruption strategies proposed or established to mitigate both the causal factors and the accumulated level of corruption (Shan et al. 2015; Smith 2009; Ameyaw et al. 2017). The ACMs are, therefore, considered to have a negative influence on the causal factors of corruption, the accumulated level and impact of corruption and the risk indicators of corruption within the procurement process (Le et al. 2014a). The influence of the ACMs on the negative constructs of corruption is therefore represented with the negative notation sign (-).

Moreover, while the ACMs are designed to mitigate the overall level of corruption in a given context, extant literature revealed that some, if not most, of these ACMs struggle to achieve their full potency, especially in the developing context. Owusu and Chan (2018) investigated this supposition and identified 17 established factors reported to hamper the efficacy of anti-corruption measures. The level of corruption in a given context is, therefore, not limited to only the causal factors and the risk indicators but also the barriers that hamper the efficacy of ACMs. As a result, the barriers are classified or considered as negative influencing variables (-) towards the ACMs in the CLD while they contribute (+) to the overall level of corruption (Owusu and Chan 2018). Lastly, it must be emphasized that the part of the CLD labeled corruption in Fig. 4 represent corruption in the procurement process. The variables of the respective constructs are also indicated and represented by the respective rotational notations depending on their contribution to the incidence or extirpation of corruption within the procurement process.

9.1.3 Stock-flow diagram (SLD)

Based on the CLD, the key significant measurement items or constructs that influence corruption within the procurement process are identified. The CLD was developed and converted to a stock-flow diagram with the help of an SD simulation software called Vensim. The stock-flow diagram is presented in Fig. 5. Yan et al. (2012) pointed out that to ensure the appropriate quantitative analysis to be conducted, their respective index for each of the measurement items should be stipulated. The solicited data from the experts were examined to ascertain the model's equations and parameters validity.

Before running the simulation, a series of tests were performed to check the validity of the model (Ding et al. 2016; Senge 1990). The validity test is performed to ensure that the certainty and veracity of the model typifies a true reflection or scenario of the real world (Richardson and Pugh 1981). The series of tests performed to review and highlight the validity of the models are 1) the boundary adequacy test; 2) parameter verification test; 3) dimension consistency test; 4) extreme condition test and 5) structure verification test. All these tests were performed and successfully passed. An example of two of the tests (i.e., structure verification test and the dimension consistency test) are explicated as follows.

The structure verification test measures the consistency of the model structure to the pertinent descriptive knowledge proposed or developed a model system (Ding 2016; Marzouk and Azab 2014). In response, all the variables, constructs, and information on the composition and the relational attributes captured in the CLD or founded on a germane and comprehensive review of extant and previous literature as well as the analysis of the data retrieved from the expert survey. Thus, the structure of the model is family and logically rooted in the actual instances of the reported cases of corruption.

Also, regarding the dimension consistency test, the software employed for this SD model development and analysis (i.e., Vensim) contains an integrated measurement function which automatically examines and verifies the recorded dimensions after the measurement units of all the variables have been defined. The developed model has, therefore, been verified for its dimension consistency with the help of the software.

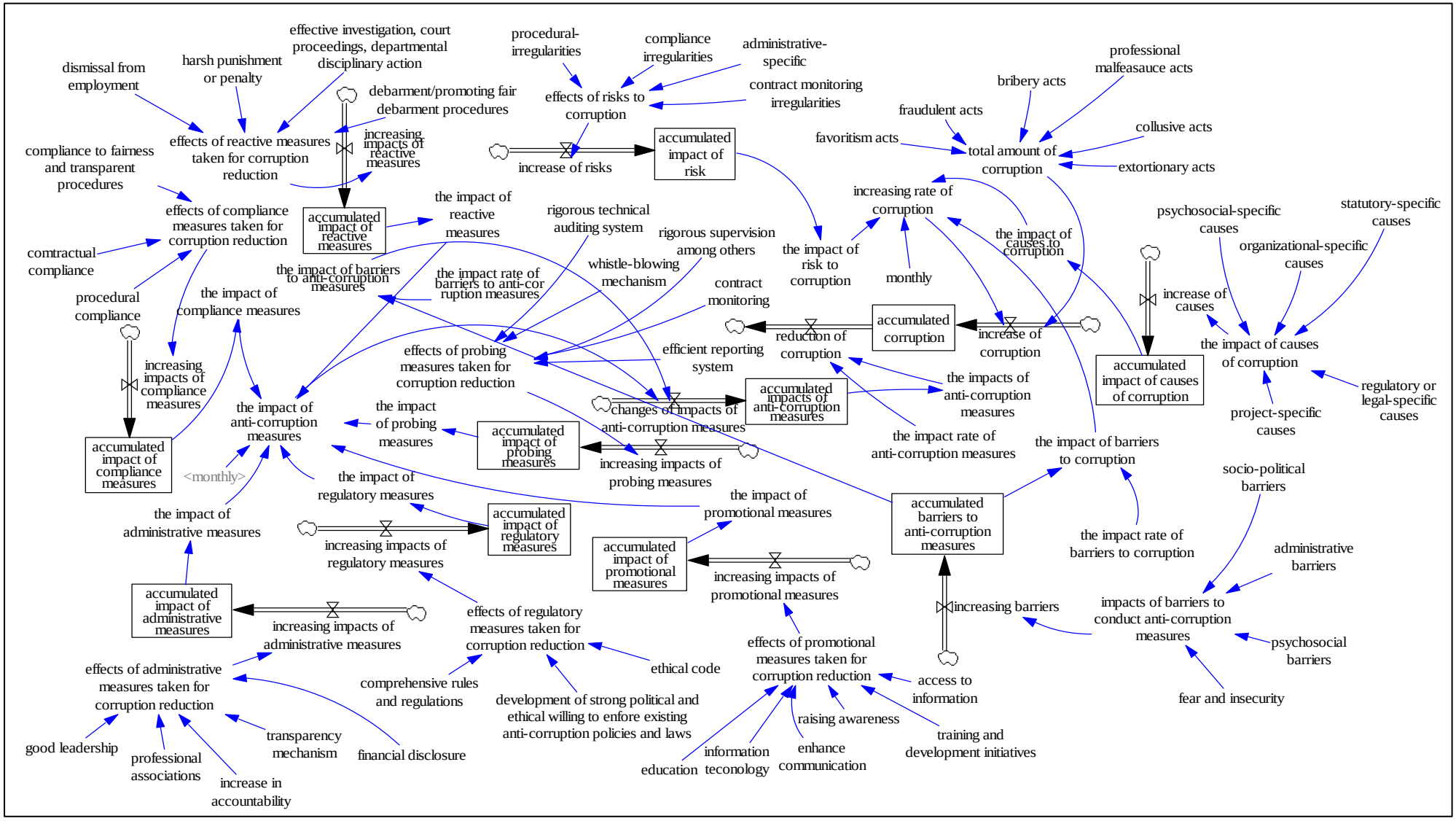


Figure 9.3: Stock flow diagram

Following the simulation, a proposition of adjusting the significant variables under each context was established to develop the best-case scenario of how the impact of corruption can be reduced, and the individual anti-corruption measures enhanced. Unlike the negative variables that scored between the range of 3.5 and 4.5 (i.e., critical), all the variables under the ACMs scored between the range of 2.5 and 3.5. This demonstrated that the overall effectiveness of the ACM construct was neutral. As a result, the accumulated impact on the measures was relatively lower as compared to the criticality of the variables under the negative constructs. This reemphasizes on the high criticality of corruption within the developing context coupled with limited or neutral effectiveness of anti-corruption measures.

Moreover, similar to the proposed simulation run for the negative constructs where the criticality of the significant variables was reduced by one (i.e., critical variables), the effectiveness indexes of the significant ACMs were, in turn, increased by one. Given this scenario, if a significant variable scored 2.8 in its actual score, the proposed score was set to 3.8 (i.e., moving the variable from a neutral level to a relatively effective level. These propositions were established to test whether the proposed scenarios established under each context would have a significant positive outlook towards the extirpation on accumulated corruption in the procurement process as well as the enhancement of the efficacy of ACMs.

This proposition was made with the aim that when the needed efforts are expended on the critical variables and constructs to the point where the significant negative variables can be reduced (i.e., either from critical to neutral or from neutral to less critical), there will be a significant corresponding change in the accumulated corruption. Similarly, if similar efforts are expended on the ACMs to result in a +1 of the significant ACMs (i.e., from either less effective to neutral or from neutral to effective), a significant analogous output in the accumulated effectiveness of the ACMs would occur. The outcome for the proposition made is intended to strengthen the notion or the proposition that the efforts towards the mitigation and extirpation of corruption in infrastructure procurement should be strategic and timely. Instead of paying attention to all the variables and other related constructs at the same time, a

more focused effort can be expended on the few critical constructs and the most significant variables in both cases (i.e., negative constructs of corruption and ACMs). This supposition can be grounded or deduced from the simulation results obtained in this study, as the results indicated the innermost degrees of difference in both the constructs. Whiles Fig. 6 presents the actual and the predicted output of the accumulated corruption over a given timeframe, Fig. 7 also presents both the actual and the predicted output of the accumulated ACMs.

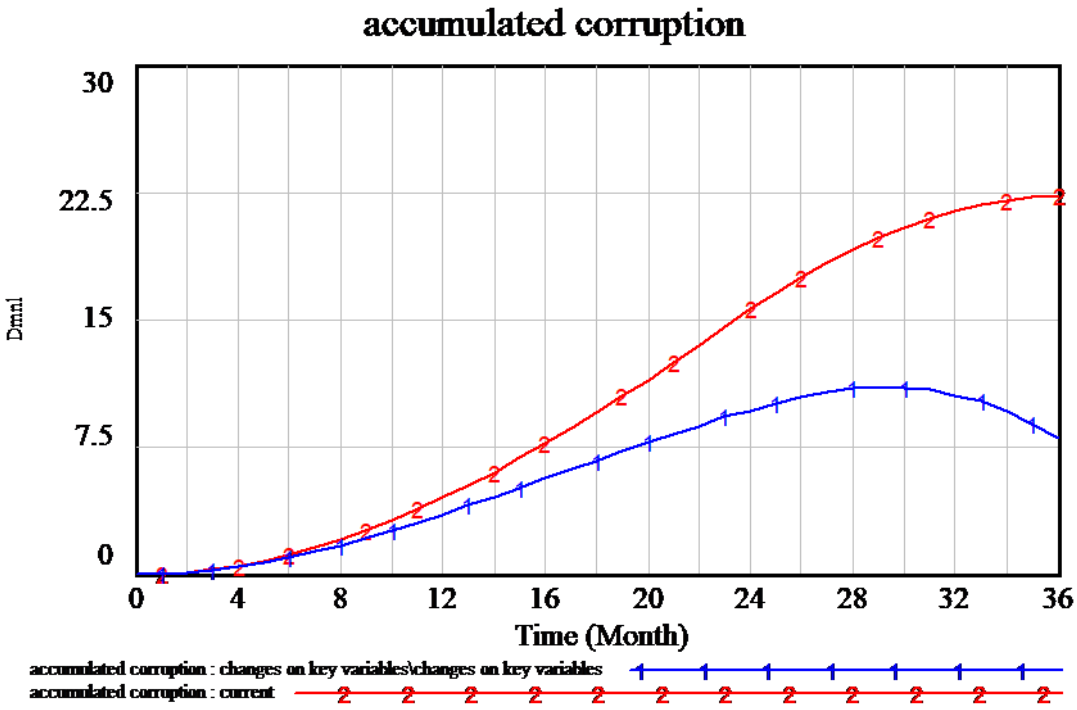


Figure 9.4: Simulation results of actual and predictive accumulated corruption

Figures 6 and 7 show the accumulated impact of corruption and that of anti-corruption measures within an estimated timeframe of 3 years or 36 months. The proposed or estimated boundary conditions are established to highlight the degree of the criticality of the negative constructs of corruption as well as the effectiveness of the anti-corruption measures as the month progresses from 0 to 36. It must be emphasized that the accumulated impact of corruption highlights the overall effect of the constructs of corruption. They include the total estimated criticalities of the forms of corruption, the causal factors

of corruption, risk indicators or procurement irregularities, and the barriers that hamper the efficacy of ACMs. As presented earlier, each of the constructs is made up of their respective underlying variables.

Given the actual simulated results, which indicated an accumulated corruption impact of over 22 degree of criticality index, a proposition was made to reduce the critical variables by 1. The measurement scales attributed to the measurement items were stipulated in a given range of 1 to 5, where 1 represented not critical, 5 = very critical, and the neutral point set at 3. For instance, using the construct of the causal factors of corruption as an example, two out of the five established factors were identified to be critical. They are Psychosocial-Specific Causes (PSSC) with a criticality index of 3.61 and Statutory-Specific Causes (SCC) also with a criticality index of 3.58. Per the stipulated adjustable requirement, the actual indexes of these two measurement items were reduced by 1 each. Thus, the prosed CI for PSSC was adjusted to 2.61, and that of SCC was adjusted to 2.58.

The other three constructs remained unchanged since the emphasis was only on the critical and significant measurement items. Similar adjustments were made to all the significant measurement items of the remaining negative constructs. As a result, the actual situation of the accumulated corruption within the context under study revealed an index of over 22.5 (red cumulative curve). On the other hand, the proposed adjustment resulted in a significant drop-down of the accumulated impact of corruption by over a difference of 15 to 7.5. The implication here is that a slight adjustment to any of the significant constructs will result in a significant increase in the overall impact of the ACM.

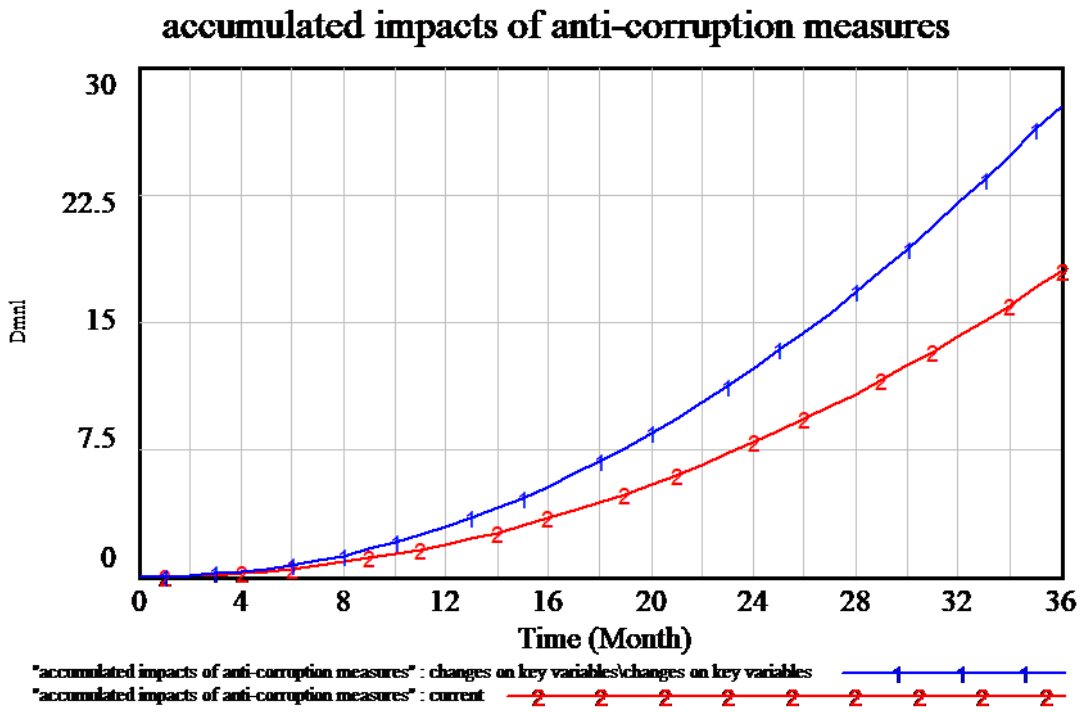


Figure 9.5: Simulation results of actual and predictive accumulated impacts of ACMs

Moreover, as established earlier, this study does not only focus on the mitigation of the accumulated impacts of corruption but also the enhancement of the effectiveness of the ACMs. Thus, similar to the propositions made to adjust the significant measurement items of the negative constructs, an adjustment was made to the significant measurement items within the ACM construct in the context under study. Given the same conditions for the simulation process of the negative constructs, a significant increase in the accumulated effectiveness of the ACMs was noted. Whiles the red cumulative curve represents the actual simulated effectiveness of the ACMs construct; the blue cumulative curve represents the predictive outcome proposed simulated results. It can be established that the comparative dispositions of the actual simulated results on both the accumulated corruption and the ACMs constructs show a significantly disparate finding (i.e., the criticalities of the accumulated corruption impacts way beyond that of the ACMs construct). This is unsurprising as most countries in the developing context, such as Ghana are noted to have high criticality indexes of corruption coupled with either neutrally effective or low effectiveness of existing ACMs (Transparency International 2019; Ameyaw et al. 2017).

In essence, the implications of the results reveal that corruption in infrastructure procurement can be mitigated or extirpated with time and strategic focus. That is, given that critical attention is expended to the implementation and the application of the most significant ACMs, and the mitigation of the most significant negative constructs prevalent in the procurement process. Thus, aside from the initial propositions made, this study further contends that it may not be helpful to focus on all the underlying constructs of corruption (i.e., both the negative constructs and the ACMs) in a corrupt-prone context, all at once. Instead, critical considerations be given to the significant constructs captured under both constructs at a given time. Once improvements are recorded, then it will be needful to consider other less significant constructs. For instance, it is valid to propose in the context under study that out of the 5 constructs capture under the causal factors of corruption greater amount of efforts can be geared towards PSSC and SSC. Similarly, regarding the irregularities, more attention can be diverted towards administrative-specific and compliance irregularities. Similar efforts are required to be expended on the other constructs to ensure a strategic fight against the incidences and effects of corruption in a given context.

9.2 Anti-Corruption Framework: Ex-ante and Ex-post Classification

According to the study of Kaufmann (1997), whereas ex-post measures refer to curative measures, ex-ante measures referred to as preventive measures. Owusu et al. (2019) categorize the measures into three main constructs, namely proactive (or preventive) measures, promotional measures, and reactive measures. Thus, per the descriptions of the classifications, ex-post measures are synonymous to reactive measures, whereas ex-ante measures align with proactive and promotional measures. Other constructs captured under the proactive measures include; administrative measures, regulatory measures, and compliance measures.

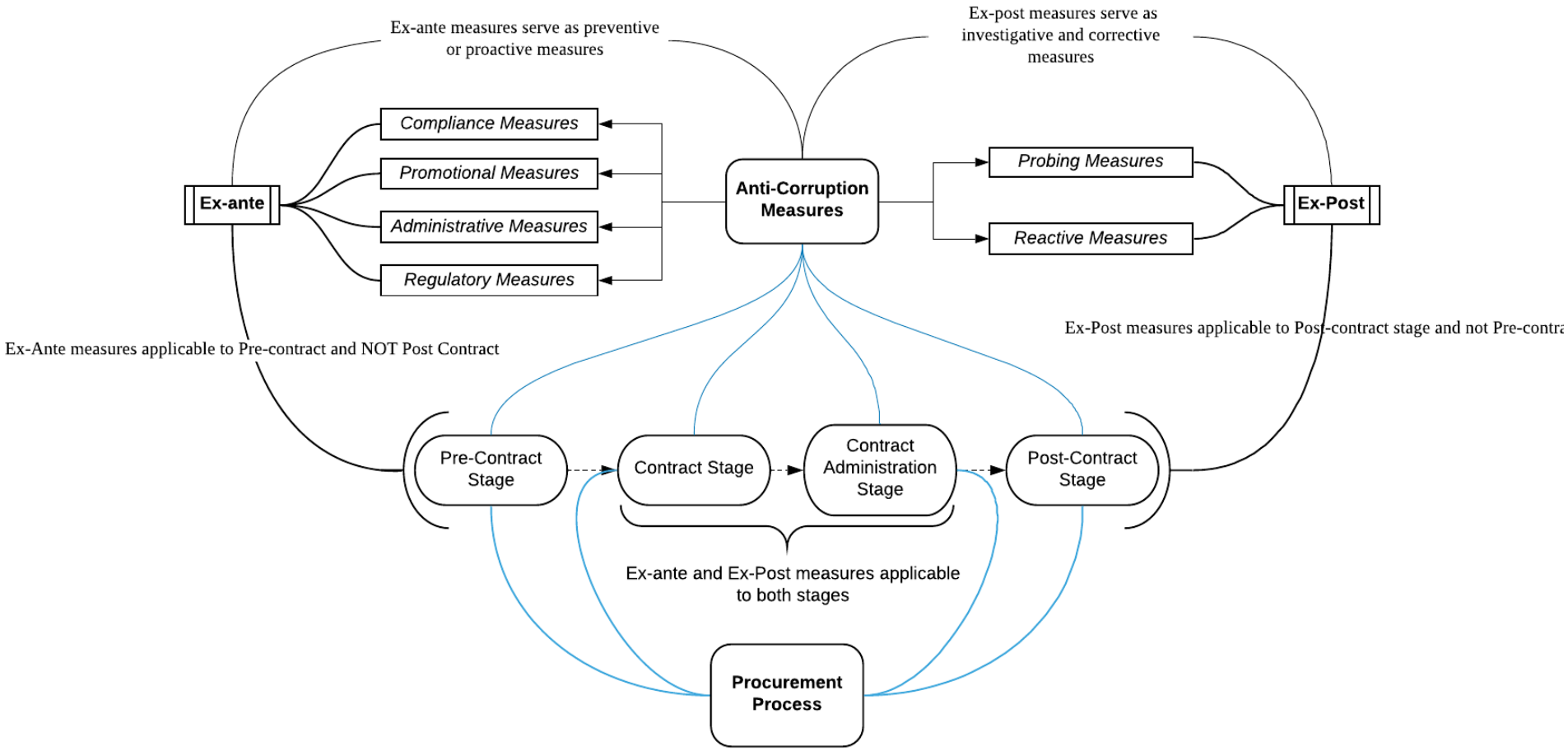


Figure 9.6: Anti-corruption constructs application within the procurement process

From the findings, it was determined that none of the activities captured throughout the pre-contract stage of infrastructure-related works to the post-contract stage is free from corruption. Simply put, when it comes to the lifecycle of infrastructure projects, there are no specific boundaries within which the extent and impacts of corrupt practices are limited. Thus, from the planning stage, which involves critical decisions such as the size and the definition of the project's requirements to the post-contract stage, corruption can show up at any time and within any of the stages. The extent to which corruption is endemic at any of the stages underpins the stipulation of ACMs in both ex-ante and ex-post processes. Figure 7 presents the applicability of the ACM constructs within the contexts of ex-ante and ex-post processes. Anti-corruption frameworks or tools are argued to be ineffective or likely to be ineffective if the framework does not encapsulate all the developed constructs captured under both ex-ante and ex-post timelines. Over-reliance or excessive focus on ex-post measures at the expense of ex-ante will not only cripple the framework but can create systemic loopholes that facilitate corrupt acts (Kaufmann 1997; Owusu and Chan 2019). However, an appropriate combination and application of measures stipulated within the processes of ex-ante and ex-post is identified to be relatively effective.

9.3 Chapter Summary

The section sought to investigate two significant objectives on the subject of corruption in infrastructure project procurement. Following the identification of the impacted activities, the study continued to investigate how these impacts could be mitigated in the short-term or extirpated in the long-term run. As a result, the SD approach was adopted to simulate the dynamic interactions between the negative constructs of corruption, the procurement process, and the strategies established to mitigate corruption. Using a proposed boundary condition for the application of the simulated results, the CLD (which highlighted the suggested relational attributions of all the constructs) was initially developed. This was done to facilitate the development of the stock-flow diagram and further analysis of the retrieved data. All the relevant model validity and reliability tests were performed to authenticate the pre and post-simulation results. The data used was solicited from 62 experts involved in the procurement process of infrastructure works. The initial results revealed a gradual acceleration of the accumulated corruption

impact derived from the collective impacts of the negative constructs of corruption. An analogous trend was identified with the ACM constructs. However, the accumulated impact of the ACM construct was revealed to be relatively lower even though it demonstrated a possible increase in its effectiveness over time. A supposition was made envision a more realistic and best-case scenario for reducing the impact of the accumulated corruption and increasing the effectiveness of the anti-corruption measures. That is, the variables that were identified to be significant were adjusted and simulated. The simulated results demonstrated revealed a drastic decline in the accumulated corruption impact as well as enhanced accumulated effectiveness of the ACMs over the 36-month used for the simulation. While the results provide a piece of very resourceful and valuable information on how to tackle corruption within the procurement process of infrastructure works in the developing contest, the approaches used in this study can be replicated in other contexts to demonstrate how corruption in different settings can be tackled.

Given that the analysis conducted in this study remains the first to examine and report on the dynamics of corruption in infrastructure-related works, this study extends the body of knowledge on the subject matter. Consequently, the developed models are intended to facilitate the decision-making process to reduce or extirpate the impact and the effect of corruption within the procurement process and, at the same time, increase the effectiveness of anti-corruption measures within the process. Thus, it offers practical information to anti-corruption activists, project managers, procurement officers, supply chain managers and researchers on a proposed mechanism for reducing the impact and the criticality of the negative constructs of corruption and enhancing the anti-corruption measures and also reinforcing the weak and corrupt-prone activities within the procurement process.

9.4 Validation of Variables Constructs and Models

Research validation (RV) is regarded as the ultimate and one of the most significant stages of a research study process (Hu et al. 2016). RV is mostly conducted to evaluate the acceptability and the credibility of the research outputs and the models developed (Yang et al. 2010; Ameyaw et al. 2014). According to Yeung (2007), the RV measures the suitability, reliability, practicality, objectivity, and the appropriateness of the developed frameworks or systems). More specifically, RVs are performed to examine the degree to which the generated outputs and the developed models fulfill or satisfy the needs of the user or the consumer of the outputs and the models (Gupta 1991, Osei-Kyei and Chan 2015). However, according to Sargent (1991), there are no specific criteria or stipulated procedures for identifying specific RV techniques or tools for carrying out the RV process. This has been viewed as one of the key challenges in RV. Thus, Law (2007) advocated that RV always relies on a study's specific propose.

Owing to the definition postulated by Lucko and Rojas 2010), RV is concerned with or attributed to doing the right thing, different from research verification, which is concerned with or attributed to doing things right. RV, therefore, aims to ensure that all the individual procedures associated with the study's methodology strictly/ rigorously conform to the most stringent quality standards to produce quality, reliable and credible output acceptable by its final consumers. As such, the relevant measurement items that RV considers are the accuracy, precision, adequacy, and the usability of a framework or a system.

While Yang et al. (2010) highlighted and explicated two approaches of RV (i.e., qualitative and quantitative), Lucko and Rojas (2010) mentioned and explained six different forms of RV in CEM research. They are criterion validity, construct validity, content validity, face validity, internal validity, and external validity. In explicating the two approaches (i.e., qualitative and quantitative), Ameyaw (2015) pointed out that the qualitative approach adopts a non- statistical technique such as opinion-based data. Moreover, the quantitative approach adopts an objective and numerical - based data to test for hypothesized correlations among measurement items. This study, however, adopted the qualitative

method of validation since all the identified constructs and their underlying measurement items are considered to be abstract items that are relatively difficult to quantitatively evaluate. Thus, conducting an expert survey to gather opinion-based data was noted to be more appropriate as compared to the other evaluation criteria. Experts from both Academia and the industry were invited to take part in the survey. This was done via a face-to-face approach. The RV period lasted for eight consecutive weeks. The backgrounds of the experts are presented below. Each section of the questionnaire was made up of both open-ended and close-ended questions. All the developed close-ended questions were assessed based on a five-point Likert scale. The biodata of the experts involved in the RV is presented in Table 9.1.

Table 9.1: Respondents' Data

I/EV	Sector	Institution	Position	Years of Experience
A.	Public	Millennium Development Authority	Senior Procurement Specialist	40 years
B.	Public	Kwame Nkrumah University of Science and Technology, Ghana.	Senior Lecturer, GhIS Fellow, Lead Director for MSc. Procurement Program	35 years
C.	Public	Ghana Institute of Surveyors (GhIS)	President	33 years
D.	Public	Public Procurement Authority	Director, Compliance and Monitoring Evaluation	30 years
E.	Public*	Kwame Nkrumah University of Science and Technology	Head, Department of Building Technology	25 years
F.	Private	Moderntech Construction Ltd.	Technical Director	20 years
G.	Public*	KNUST Procurement Office	Chief procurement officer	20 years
H.	Private	Construction Cost Consult	Managing Director/Senior Quantity Surveyor	15 years
I.	Private	Procurement and Project Management Consultancy (PPMC) Ltd.	Procurement Manager	12 years

J.	Private*	Deliren Construction Ltd.	Chief Quantity Surveyor	11 years
K.	Public	Architectural and Engineering Services (AESL)	Deputy Quantity Surveyor	10 years
L.	Public	Architectural and Engineering Services (AESL)	Deputy Quantity Surveyor	10 years

Note: I/EV stands for Interviewee/ Expert validator; GhIS represents Ghana Institute of Surveyors

In all, a total of 12 experts were involved in the survey. With the minimum years of experience being ten years, all the experts involved were identified to occupy senior position in their respective institutions and sectors. Other criteria for selecting the experts were as follows: 1) involved in the supply chain of infrastructure procurement and delivery in the Ghanaian context and 2) involved in the contractual arrangements of projects and either witnessed or understands the dynamism of corruption in infrastructure projects.

9.4.1 Validation Results

Six sets of questionnaires were developed and explored (via an expert survey) to highlight the credibility and the outputs of the results generated (both as an individual or stand-alone constructs) and towards the developments of the models. Thus, all the constructs and their relational attributions to the developed models were examined. They include the forms of corruption and their associated causal factors, the contextual risk indicators, extant anti-corruption measures, and the barriers that hamper the efficacy of the measures. Lastly, the RV regarding susceptibility patterns of the procurement process was conducted (Table 9.1). Thus, each of the six constructs highlighted represents a set of questionnaires. The questions asked in relation to the constructs to determine their RV are presented in Table 9.2.

Table 9.2: Validation Results

No	Constructs and their respective underlying measurement items	Mean
	Procurement Irregularities	
P1	Are the 18 procurement irregularities established, critical in the Ghanaian infrastructure procurement?	4.36
P2	Do the 18 procurement irregularities obscure the normal process of infrastructure procurement in Ghana?	4.18
P3	Can the 18 procurement irregularities established, contribute or create room for corruption to occur?	4.54
P4	Can the impact of their criticalities have adverse effects on the general economy?	4.55
P5	Are the probability and severity rankings of the identified irregularities reasonable?	4.00
	Forms of Corruption	
F1	Are the 27 forms of corruption prevalent in the process of infrastructure procurement in Ghana?	4.54
F2	Can the 27 forms established contribute to the forms of corruption in the procurement sector?	4.46
F3	Are the 27 forms of corruption established, critical in the Ghanaian infrastructure procurement?	4.36
F4	Do the impacts of their criticalities have adverse effects on the procurement sector and the general economy?	4.54
F5	Are the rankings of the identified forms reasonable?	4.27
	Causes of Corruption	
C1	Are the 38 causes of corruption established, critical in the Ghanaian infrastructure procurement towards the incidence of corruption?	4.46
C2	Do the 38 causes of corruption obscure the normal process of infrastructure procurement in Ghana?	4.55
C3	Can the 38 causes of corruption established contribute or create room for corruption to occur?	4.54
C4	Are the rankings of the identified causes reasonable?	4.46
	Anti-Corruption Measures	
A1	Are the 26 anti-corruption measures established, important towards the eradication of corruption in the Ghanaian infrastructure procurement?	4.18
A2	Are all 26 anti-corruption measures moderately effective in the procurement process as rated by the respondents?	3.91
A3	Can the 26 anti-corruption measures established contribute or create transparency and accountability in the procurement process?	4.27
A4	Can the impact of their effectiveness contribute to the good image of the public procurement sector and the general economy?	4.45
A5	Are the rankings of the identified measures reasonable?	4.00
	Barriers Against the Efficacy of Anti-Corruption Measures	
B1	Are the 17 barriers established, critical in the Ghanaian infrastructure procurement?	4.50
B2	Do the 17 barriers impede the effective application of and enforcement of anti-corruption measures in the procurement process in Ghana?	4.27
B3	Can the 17 barriers established contribute or create room for corruption to occur?	4.09
B4	Can the impact of their criticalities have adverse effects on the general economy?	4.40
B5	Are the rankings of the identified barriers reasonable?	4.20

The questions presented in Table 9.2 are developed to support or justify the individual measurement items and their respective constructs in the development of the fuzzy model, the PLS-SEM model, and the System Dynamics model. As such, the questions were posed to determine the following sub-questions: Construct validity measures the degree to which the measurement items within a specific construct measure or address the theoretical domains of the actual construct it claims to measure (Ameyaw 2015). Thus, in this study, a typical question, posited to measure this RV is demonstrated as: Are the measurement items and their respective constructs appropriate for the development of the models? In all cases, the experts demonstrated that the measurement items within their respective constructs adequately measure the actual construct they claim to measure. For instance, taking the forms of corruption as an example, do the underlying constructs such as bribery acts, collusive acts, discriminatory acts among the other forms adequately measure the construct of the forms of corruption. These questions (on the model) in harmony with the underlying contracts and the measurement items were posed to determine five out of the six mentioned types of RV. The five are 1) Content validity, 2) face validity, 3) external validity, 4) internal validity and 5) construct validity.

In explicating the individual types of validity, Lucko and Rojas (2010) pointed out that the first type, which is the content validity, represents a non - statistical technique that examines the fair representation of the output to reality. Simply put, does the study's content fairly reflect or represents the actual case in real life. At this stage, the key focus is the degree to which all the underlying measurement items with their respective constructs can facilitate or contribute towards the enhancement of the established ACMs and the curtailment accumulated corruption on the procurement process provided that they are strategically enforced with continual attention (Ameyaw and 2015; Babbie 1990). A typical question posed to evaluate this type of RV is: Can the respective measurement items with their established constructs and the developed models contribute or create room for corruption to occur? (P3). In all cases, the experts revealed or highlighted the validity of the measurement items in terms of the content with the score of each question obtaining an MS of more

than 4.00, Which means very good (Fig. 9.6). Similar to content validity, face validity is a subjective non-statistical technique that gathers subjective data from experts to evaluate a study's validity. Face validity measures the level of agreement between the generated output of the study and the experts' consent of the results in tandem with practice. Thus, in a nutshell, the face validity reveals whether the expert's assessment on a given list of measurement items agrees with what happens in real practice. Examples of the questions posed to address this type of RV are as follows: Are the 18 procurement irregularities established, critical in the Ghanaian infrastructure procurement? – Are the developed models effecitive to be employed or facilitate decision making? (P2). Again, the results generated among all the constructs were revealed to be greater than 3.5, which indicates good (Fig.9.6).

Next, internal validity measures the appropriateness of a study and also the extent to which the generated outputs are free from errors. Thus, this particular type of RV examines the logic of the procedures adopted to arrive at the final output (Lucko and Rojas 2010). Questions regarding the internal validity included: 1) are the models developed easy to understand? 2) Is the model outputs logical? 3) are the steps adapted to arrive at the final model, logical to the extent that other practitioners or experts can replicate it? (P4). With the MS identified to be greater than 4.0, the results reflect the appropriateness of the study or the confirmation of the logic to arrive at the established outputs.

Lastly, external validity shows how a research study's output can be generalized for prediction or forecast purposes (Ameyaw 2015; Leedy and Ormrod 2001). Thus, since this type of RV interrogates whether the results generated from a study can be generalized to the general population, one of the key measuring items for estimating the index for this indicator is to ensure that the respondents selected for the RV will yield representativeness (Osei-Kyei 2017). In this study, the questions posed on the reasonability of the lists' rankings are developed to test the external validity of the established measurement items and their respective constructs towards the development of the models. Another typical question is as follows – Is the overall output of the model suitable to contribute to the efficacy of anti-corruption measures and lead to a decline in the overall impact of corrupt practice in the

procurement process? (P5 in Fig. 9.6). The acceptable limits of the mean score used to measure all the types of R V in all the cases were given to be 3.5 to 5, which represents very good to excellent. Figure 9.2 typically reveals how all the measurement items used to measure the different forms or types of the RV fall within the acceptable stipulated range.

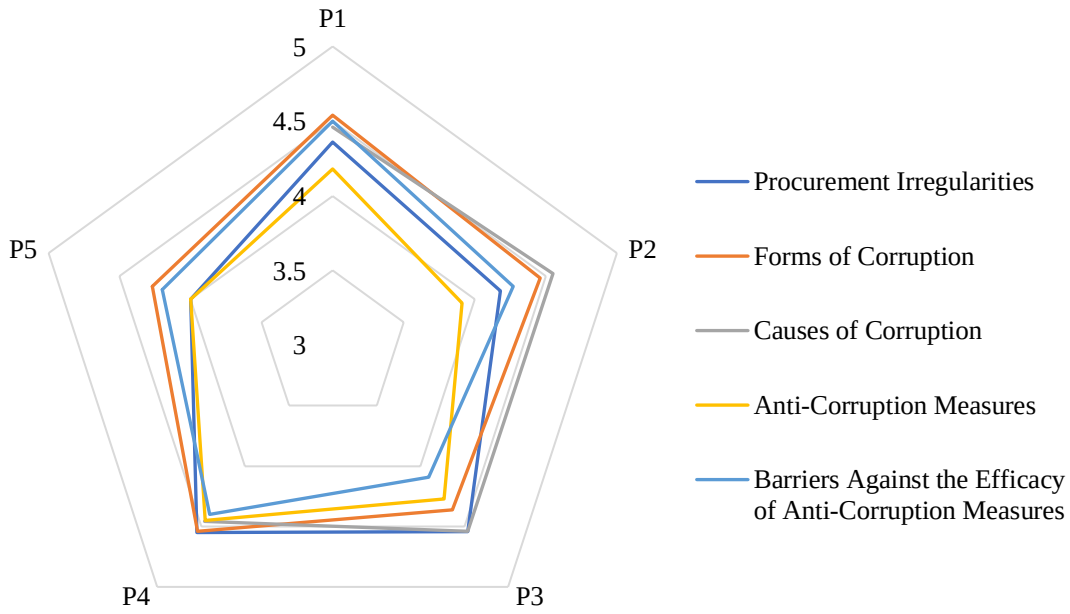


Figure 9.6: Graphical representations of the constructs contributions towards the models' validity

9.5 Chapter Summary

This chapter presented the dynamic framework highlighting the interactions of the various constructs of corruption and their accumulated impact on the procurement process. Thus, while the expert survey revealed the accumulated impacts of the current criticalities of the corruption constructs on the procurement process, a proposition of slight adjustments to the significant constructs captured were made to determine the responsive changes to the adjustments made. The model revealed and confirmed that efforts taken to produce either a fair or the slight changes to the significant constructs could cause a very significant increase in the effectiveness of the anti-corruption measure and a significant decline to the accumulated impacts of corruption on the procurement process over a fairly appreciable amount of time. The results reflect the ideology underpinning the Pareto's principle. (i.e., 80/20 rule). That is,

efforts taken to implement the 20% slight adjustments on the constructs can reflect /cause a significant 80% output in the changes needed.

CHAPTER 10 – CONCLUSIONS AND RECOMMENDATIONS

10.1 Introduction

This chapter concludes this research. While the topic of corruption is noted to be an unending phenomenon, this research targeted to contribute to corruption-related studies within the domains of project management and construction management. Thus, while the significance of each section and chapter of this research had been explicitly indicated at the respective sections and chapters, this chapter presents the overall contribution of this research to the related scholarships. The practical implications for the industry are further detailed out in the chapter. Lastly, the research limitations, in addition to the recommendations for future research, are presented in this chapter. The next section of this chapter presents the review of the aim and accompanying objectives of this research.

10.2 Review of the Research aim and objectives and their significance

The aim is to explore the dynamism of corruption in public project procurement in the developing and the developed contexts, however, placing more emphasis on the developing context and to develop a soft computing model to predict and evaluate the corruption within the procurement process and propose an overarching dynamic framework potent and resilient enough to extirpate and resist respectively, the negative constructs of corruption within the procurement process.

1. Examine the forms of corrupt practices and their respective causes that auger the practices of corruption in public infrastructure procurement;
2. Examine the procurement irregularities in the developing context;
3. Establish the stages in procurement and their susceptibility to corruption with respective strategic measures to curb its incidence;
4. Investigate the effectiveness and the barriers to effectiveness of the anti-corruption measures;
5. Develop a dynamic overarching model to mitigate corrupt practices in public procurement.

The main aim, including the individual objective, was achieved using appropriate methods and techniques explained in Chapter 2. The methods include but not limited to, expert surveys and interviews, literature reviews, and document (A-G reports and ICAC reports) analysis. The succeeding sections present the major findings and conclusions for every objective. This study is one of the first empirical studies to comprehensively examine all the constructs of corruption within the procurement process. This study contributes significantly not only to the body of knowledge the corruption-related studies but also a practical contribution towards the effective development of focused anti-corruption measures. Particularly, the findings of each of the stipulated objectives offer very useful and practical implications towards the extirpation of corruption in the developing world, especially in Ghana.

Objective 1: Examine the forms of corrupt practices and their respective causes that auger the practices of corruption in public infrastructure procurement

A comprehensive review was conducted to identify the prevailing forms of corrupt practices and their associated causal factors in infrastructure projects. In all, twenty-eight forms were identified. However, twenty-seven were noted as applicable in the Ghana context. Over forty-four factors on causes of corruption were as well identified in a review study conducted to identify the prevailing causal factors behind the criticality of the forms. First, the identified forms were clustered under five categorical constructs, namely; bribery acts, fraudulent acts, collusive acts, discriminatory acts, and extortionary acts. An additional construct labeled unclassified acts. Per the review, the most discussed constructs in descending order were fraudulent acts, bribery, and discriminatory acts. An empirical analysis regarding the forms was conducted to 1) identify the criticalities of the individual forms of corruption in infrastructure projects. 2) assess the impact of the forms of corruption on the procurement process of infrastructure works and the criticality of the constructs at the various stages and activities captured under the procurement process.

The findings revealed that bribery acts' construct and professional malfeasance acts (initially labeled as the unclassified construct) and collusive acts were noted as the leading constructs of CFs in infrastructure projects. Results regarding their criticalities within the procurement stages and their respective activities were conducted in a comparatively. Thus, a contextual comparative analysis was conducted between the results of the developing context and that of the developed. For instance, from the developing context, bribery and collusive acts dominated the critical activities such as PCS4, PCS6 CTS2 and CTS3. Others, similar results, were identified in the developed context as well but at different stages PCS2, PCS3, CTS1, and PCP3. The construct known as unclassified acts was named after the empirical survey and analysis based on the definitions and attributes of the underlying variables.

The second section of this objective dealt with the causal factors of corruption. Sub exploration included their criticality in infrastructure projects and of their overall impact on the individual stages and activities of the procurement process. As mentioned, forty-four causal factors were identified via a comprehensive literature review. Among these factors, some of the most discussed included poor professional, ethical standards, overdose relationships, and negative working conditions. Similar to the forms, the causal factors were captured under five categorical constructs, namely, regulatory or legal-specific causes (RSC), statutory-specific causes (SSC), psychosocial-specific causes (PSSC), organizational-specific courses (OSC) and project-specific causes (PSC). Among the forty-four variables, 38 variables were noted as applicable to the context of Ghana. The most critical causal factors under their respective constructs were personal greed (under PSSC), inadequate sanctions (under OSC), lack of coordination among government departments (under SSC), flawed regulation system binder (RSC) as the lack of rigorous supervision (under PSC). In addition to other constructs, the causal factors were revealed to have significant critical impacts on the activities such as CTS3, CTS4, CTS5, and other important activities at the post-contract stage including PCP1 through to PCP5.

In sum, the objective revealed the critical forms of corrupt practices and their associated causal factors in the procurement process. The results retrieved from this objective does not only facilitate the development and the enforcement of appropriate ACMS but also to facilitate deeper investigations into these affected stages and activities on how to develop reinforcing mechanisms to reinforce the entire process against corruption.

Objective 2: Examine the procurement irregularities in the developing context

This objective was established to examine the criticalities of procurement irregularities and evaluate the credibility and reliability of the identified suppositions. In realizing this objective, three sub-objectives were established set. They are: 1) systematically review the relevant documents to identify the prevailing procurement irregularities or risk indicators identified in infrastructure procurement in the context of developing countries, particularly Ghana; 2) evaluate the criticality of the identified risk indicators; and lastly 3) test the hypothesis on the corruption attribution to the identified irregularities. Due to the context-specific nature of this objective, the primary documents that revealed the procurement irregularities in the context of Ghana were the periodic reports issued by the auditor general of the Republic of Ghana. The Fuzzy Synthetic Evaluation (FSE) technique, which is regarded as one of the leading soft computing tools for assessing risk, is employed to evaluate the criticality of the irregularities. Moreover, other auxiliary rigorous tools such as factor analyses, normalization, and descriptive tools are employed to factorize the identified irregularities and to test the established hypothesis. The results reveal that the sourcing of proforma invoices from the same supplier as well as compliance Irregularities was revealed to be the most critical variable and construct respective. Moreover, out of the four constructs developed, even though three were identified to be critical and one, moderately critical. The results confirm two hypothesized constructs, which are administrative-specific irregularities and compliance irregularities, to significantly contribute to risking the infrastructure works to the incidence of corruption.

Lastly, the impact of these variables within this construct, in addition to the other negative constructs were examined. As mentioned, eleven out of the twenty-one activities were identified to be highly impacted by the variables. The results obtained from this objective did not only focus on the identification and the examinations of the criticalities of the procurement irregularities but also their associated impacts. Theoretically, the relevance of this objective is attributed to its knowledge contribution by examining the criticality of procurement irregularities and testing the hypothetical stance of their contribution to the incidence of corruption. Practically, this study is intended to contribute immensely to both procurement planning and policy-making process regarding the measures to put in place to prevent or extirpate the likelihood of any of the risks' incidence. As such, the information in this study is relevant to project parties, policymakers, and anti-corruption activists within the domain of the developing context.

Objective 3: Establish the stages in procurement and their susceptibility to corruption with respective strategic measures to curb its incidence

This objective was set to establish the stages (and the respective activities) in procurement and their susceptibility to corruption with respective strategic measures to curb its incidence. First, a contemporary review was conducted to identify the procurement systems in existence. However, this section focused on the traditional procurement system since most of the activities under this system are captured at the various stages of the other systems. Twenty-one activities were identified under the procurement process, captured under four major stages or constructs. The stages are the pre-contract stage, contract stage, contract administration stage, and the post-contract stage. As mentioned, the objective of the study was to ascertain the susceptibility levels of the procurement stages and activities to corruption and also the overall impact of the constructs of corruption on the process. The other sub-objective therefore focused on the evaluation of the criticalities of the various constructs of corruption forms. Not only was this assessment conducted in the developing context, but also the developed context. This enabled a comparative analysis to be conducted. While the result indicated that the

procurement process in the developing context is vulnerable to the incidence of corrupt practices, the case of the developed context is sharply disparate. Moreover, the comparative analysis revealed the activities that resulted in the sharp disparities and how the developing context can learn from the developed to neutralize the susceptible stages from their current form to a more stable, reinforced, and resilient activities and stages within the procurement process. Particularly in the case of Ghana, not only were the activities examined to identify their susceptibility patterns, but also, the results generated facilitated the development of a fuzzy model for determining and predicting the vulnerability levels in both existing and proposed projects. This is a linear model, simple to understand, adapt, and replicate in other contexts. This objective focuses on the exploration of the irregularities identified within the procurement process.

Moreover, while the measurement and predictability of corruption are reported to be difficult due to its clandestine nature, this section also attempted to develop a measurement model for evaluating the proneness of the procurement process of construction projects to corruption. The model is developed using a soft computing approach (i.e., the Fuzzy Synthetic Evaluation technique) to assess the levels of vulnerability with respect to the stages of corruption and their corresponding activities within the procurement process of construction projects. A review of related literature produced a 21-activity list encapsulated within the four stages of the procurement process. Procurement and construction practitioners evaluated the list through an expert survey. The analysis of the survey results revealed an overall project vulnerability index, which suggests that construction projects executed in developing countries are relatively susceptible to corrupt practices. The main stages of the process that were identified to be vulnerable were the contract stage (CTS) and the post-contract phase (PCP).

This section of the study contributes to the body of knowledge on the ways of measuring the various indicators of corruption in infrastructure procurement and is, arguably, the first to employ soft computing techniques (i.e., the FSE approach) to estimate the susceptibility patterns of the various stages of the procurement process as well as develop an easy to adopt-and-use, yet standardized approach to facilitate similar estimations in future works. Practically, even though a rigorous technique

is employed, the model is developed in a manner that is easily understandable and can be adopted by practitioners such as policymakers and auditors for detecting and/or measuring the vulnerability indexes of various procurement activities and their respective stages of the procurement process to the incidence of corruption. The model can as well form the basis for researchers to develop more comprehensive tools that extend beyond the boundaries of the procurement process for predicting, measuring and offering effective measures for corrupt practices right from the definition of project's requirements through to project execution to contract close-out. Thus, contributing to a more deepened understanding of the various means of measuring corruption in the domain of project procurement and management. Lastly, the developed model provides useful insights that can inform project parties and anti-corruption activists in their efforts to implement necessary actions aimed at curbing the incidence of corrupt practices in construction projects in developing countries.

Objective 4: Investigate the effectiveness and the barriers to effectiveness of the anti-corruption measures

This objective reviewed the anti-corruption measures (ACMs) developed to mitigate the pervasiveness of corruption in construction project management (CPM). Using a two-stage methodological process to identify the relevant publications needed, 39 unique ACMs were identified in 38 selected publications. The leading ACMs identified are ethical codes, transparency mechanisms, training, and development initiatives. A conceptual framework constituting six thematic constructs was developed to facilitate easy identification of ACMs and the categorization of future developments of ACMs. They are regulatory, managerial, probing, compliance, promotional, and reactive measures. The findings contribute an in-depth understanding of ACMs in CPM and are useful for further empirical research. Following the retrieval and the categorization of the variables into their respective constructs, two surveys were conducted. First, a global expert survey was conducted with 65 experts from around the world involved in infrastructure project procurement and management using the purposive sampling technique. The analysis was conducted on a contextual comparative basis, thus, comparing the views of experts from the developed countries against the experts from the developing countries. The leading

barriers identified by the respondents from the developing context were the absence of political will by government officers and statutory professional councils to fight corruption and personal attitudes, which include the lack of will to become involved in fighting corruption. The respondents from the developed world revealed that non-familiarity with ethical codes, the fear of being caught reporting, and personal attitude were the leading barriers. The Mann-Whitney U test was used to analyze the statistical difference regarding the barriers' criticality between the two contexts. This study contributes to a deepened understanding of corruption by examining the criticalities of barriers to the effectiveness of ACMs, which have not received the needed attention in the past. The study also reveals that the prevalence of corruption in infrastructure projects is not attributed to the causes and vulnerabilities only; it is also attributed to the identified barriers. This study informs policymakers, anti-corruption institutions, and academic and industrial researchers about the barriers that are likely to be encountered in enforcing and applying the stipulated ACMs. It is also intended to contribute to the strategic development of a more holistic approach to annulling corrupt practices in project procurement and execution.

Secondly, the section employed the fuzzy synthetic evaluation (FSE) technique to assess responses retrieved from experts involved in the procurement and execution of infrastructure-related projects using the purposive sampling technique to reach the experts in Ghana. Even though none of the variables nor constructs was identified to be effective, the probing measures' construct was identified to be the highest-ranked construct, followed by managerial measures. Moreover, all of the remaining constructs with their variables were revealed to be moderately effective. The rationale behind this explorative study is to ascertain how effective the existing anti-corruption measures stipulated to check, thwart and extirpate corrupt practices in infrastructure project procurement and management perform in developing countries and to reveal the ineffective measures that need reinforcement in order to make them resilient. This section of the research theoretically contributes to the body of knowledge on corruption in infrastructure-related studies and adds to the deepened understanding of the subject matter. Practically, this objective revealed useful information for project parties, policymakers, anti-

corruption institutions and researchers towards the reinforcement of the existing measures for the expurgation of corrupt practices in infrastructure projects' procurement, execution, and management.

Objective 5: Develop a dynamic overarching model to mitigate corrupt practices in public procurement

The last objective encompasses all the first four objectives to establish the overarching framework for the study. It encapsulates the dynamics defining the vulnerabilities of the activities and the stages within the procurement process, the criticalities of the causal factors, the procurement irregularities or risk indicators, the effectiveness of the anti-corruption measures, and the criticalities of the barriers that hamper the efficacy of the anti-corruption measures. Three comprehensive models are developed in this section. The first two models serve as the foundational models for the final third and final model. The established the relational impacts of the criticalities of the negative constructs on the procurement process. The second model examined the significant correlations of the barriers against the effectiveness of ACMs on the respective constructs of the ACM. Finally, the third model dynamically examines all the constructs within the first two models to propose a final framework for reducing the criticalities of the negative constructs and, at the same time, enhancing the efficacy of the anti-corruption measures.

The first model examined the relational effects of the constructs of corruption on the procurement activities and stages. In general, eleven out of twenty-one stages were noted to be highly impacted by the constructs. Among the eleven impacted one activity was identified under the pre-contract stage, three out of five activities of the construct stage, two out of four at the contract administration stage, and five out of six activities at the post-contract stage. Thus, none of the stages was exempted from the criticalities of the constructs of corruption. Per the analysis, the only activity that was identified to be significantly impacted by the corruption constructs was PCS6 (that is, the receipt of leaders). While PCS4 (obtaining necessary approvals) and PCS5 (soliciting tenders) were noted as the most susceptible activities to corrupt practices, the network analysis revealed PCS6 (even though not as vulnerable as

PCS4 and PCS5) as the most significant in terms of the constructs' criticalities at the pre-contract stage. Moving on to the next stage (that is, the contact-stage), the three most impacted activities based on the normalized values were CTS3 (the selection of a contractor), CTS4 (awarding of contact), and CTS5 (the preparation and signing of contract). Stage three (also known as the contract administration stage) also recorded similar results as compared to the previous stage.

Two out of four activities were identified to be impacted by the collective force of all the variables captured under the negative constructs of corruption. The two activities are CAS1 (issuing of contract amendments) and CAS4 (administering progress payment). CAS4 was. However, the only activity noted to be highly vulnerable to the incidence of corrupt practices (Owusu et at. 2019). At the final stage, five of the activities were identified to be crucial regarding their criticalities to the impacts of the construct of corruption. Thus, the activities noted were: 1) completing final audits, checking proofs of delivery (project deliveries), and returning of performance bond as closing out the contract. The only activity identified to be less critical regarding the impacts of the negative constructs is the confirmation of the accuracy and completeness of file documentations. Similar findings were noted under the vulnerability assessment stage. Thus, aside from the first five activities identified to be vulnerable to corruption, the final activity within this stage (that is, PCP6) was the only activity noted to be less vulnerable to corrupt practices. This section of the objectives revealed one of the most significant findings of the study. That is, to reveal the activities within the procurement process heavily impacted by the negative constructs of corruption. The information revealed by this model is significantly useful for not only decision making regarding the criticalities of forms to extirpate but also the highly impacted activities within the procurement process that needs attention and reinforcement against the criticalities of the negative constructs.

The second model examined two main sub-objectives. They were: 1) the effectiveness of anti-corruption measures (ACMs) in project planning, procurement and management, and 2) the barriers

that hinder the effectiveness of the ACMs. It investigates the correlational impacts of noted barriers on the efficacy of ACMs in the procurement and management of public projects in the developing world using Ghana as the case study. Similar to the previous objectives, an expert survey was conducted with the same 62 professionals involved in project procurement and management. The data were analyzed using descriptive statistics, factor analysis, and partial least squares structural equation modeling (PLS-SEM). Moreover, 24 relational iterations were established and examined among the identified constructs (i.e., four barriers and six ACM constructs), and they formed the study's hypotheses. The PLS-SEM was used to test the hypotheses. The results showed that the lack of knowledge and understanding of one's right in a contractual environment and political and structural barriers were the most critical variable and construct, respectively. The PLS-SEM also revealed seven out of the twenty-four statistical relationships tested were revealed to be significant.

The socio-political barriers' construct, which happened to be the most critical construct, was revealed to have strong impacts on administrative, compliance, and promotional anti-corruption measures. The findings justify why most projects in this part of the world are plagued with political corruption and, in turn, lead to high cost and time overruns. It also shows the need to extirpate socio-political barriers to enhance the effectiveness of the established anti-corruption measures as well as limit the prevalence of corruption in project management. This study is arguably the first to examine the impacts of barriers on the effectiveness of anti-corruption measures in public projects in the developing context. The findings can facilitate the development of stringent anti-corruption measures that are more resilient to barriers. Theoretically, this study contributes to the body of knowledge regarding corruption-related studies in project management. Practically, it can inform relevant parties, such as project managers, contract administrators, project stakeholders, policymakers, and anti-corruption advocates, about the significant barriers that obstruct the effectiveness of anti-corruption measures and the need to extirpate them. Thus, contributing to the holistic development of anti-corruption measures aimed at expurgating corrupt practices during the planning, procurement, and management of public projects.

Lastly, the final model examined the dynamic nature of the constructs of corrupt practices in relation to the complex procurement process. As established in the fifth objective, which happened to be an overarching objective among the others, this section of the study sought to develop and propose a dynamic model to reduce the impact of the accumulated corruption within the respective activities of the procurement process. Moreover, the model, on the other hand, is intended to guide the decision-making process on how to strengthen the potency of anti-corruption measures. Thus, it was anticipated that all the constructs on corruption in this study would be collectively examined. Given the dynamic nature of corrupt practices (c.f. Jain 2001; Shan et al. 2017; Chan and Owusu 2017), previous methods often adopt linear approaches that fail to examine the dynamism and complexities regarding corruption. Thus, the final objective employed the system dynamics (SD) approach to examine the dynamic behavior of all the constructs of corruption within the various activities of the procurement process. Most significantly, the dynamic interactions among all the measurement items captured in the model would be revealed. The proposed dynamic model is presented to facilitate decision making on how to efficiently improve the efficacy of the established anti-corruption measures and reduce the impact and influence of corrupt practices within the procurement process. Lastly, some of the key findings to each of the objectives are presented in Table 10.1.

Table 10.1: Review of objectives' key findings

No	Objectives	Key Findings
1	Examine the forms of corruption and their respective causes that instigate or propel corruption in infrastructure procurement (IP).	1. The results demonstrated sharp disparities between the developed and the developing contexts on all the constructs examined. Thus, while the negative constructs were revealed to be relatively critical in the developing contexts, the opposite was the case for the developed context. 2. Most discussed causes of corruption in literature, Psychosocial-Specific, Organizational-Specific, and regulatory specific-causes while the most critical causes of corruption were identified as follows: inadequate sanctions and flawed regulation system at the variable level. 3. Wide disparities in forms between developed and developing countries. Out of the 27 forms examined, only three forms did not show significant statistical disparities between the two contexts. Thus, other than money laundering, deception, and professional negligence, all the remaining forms, from bribery to conflict of interest, demonstrated wide disparities in terms of their criticalities between the two contexts.
2	Examine the procurement irregularities in the developing context	1. The most critical procurement irregularities prevalent in the Ghanaian IP were noted to be: Compliance irregularities (construct level) and payments for uncompleted works (variable level). 2. Irregularities contributes significantly to the overall prevalence of corruption in the developing context 3. Development of anti-corruption frameworks should specifically contain measures to curb the criticalities and the impacts of the irregularities
3	Investigate the effectiveness and the barriers to effectiveness of the anti-corruption measures	1. ACMs more effective in the developed contexts as compared to the developing sectors 2. Most effective ACM construct that is revealed to enhance the overall effectiveness of an ACM framework is probing measures 3. Socio-political barriers were revealed to be the primary factors that impedes the effectiveness of the ACMs. 4. The effectiveness of the ACMs can be improved by stepping up some of the key ACM constructs such as probing measures such as probing and promotional measures.

4	Examine the IP stages' susceptibilities to corruption, associated forms, and respective strategic measures	1. The IP procurement process was revealed to possess varying degrees of susceptibility patterns to corruption. 2. Most dominant forms across the stages include collusive and bribery acts at the contract stages in both contexts 3. Most impacted procurement stages in the case of Ghana were contract stage and post-contract stage. 4. The contract stage was revealed to be the most vulnerable in the developing context. The developed context, as well as HK, showed relatively neutral levels of susceptibilities in all the cases.
5	Develop a dynamic model to mitigate corrupt practices in the IP process	1. No specific model or framework designed to extirpate corruption other than the PPA ACT 2003, which is void of adequate measures. 2. SD model shows that the overall impact of corruption can be effectively dealt with by mitigating some of the key negative constructs (e.g., socio-political construct). 3. Effectively strategize ex-ante and ex-post ACMs across the respective stages of the procurement process

10.3 Limitations of the study and recommendations for future research

Research limitations may be argued to be inevitable, especially because the processes and outcomes of research works are mostly unpredictable. Similar to other studies, this research encountered a few limitations, which are presented below and the recommendations for future studies proposed. The first limitation is attributed to the type of data uses in this study. While the expert survey is argued to be suitable for this study or most preferred data collection technique (Trapnell 2015), it is also widely criticized for its opinion or subjective driven nature. This approach is argued to possess some inherent flaws as it often criticized to be subjective. The subjective nature of the data may be addressed in a future study by making use of real corruption case data (if any) and probably, big data to draw justifiable conclusions and assumptions. Recently, the use of big data, coupled with the adoption of rigorous analytical tools, is becoming more common. Future works can, therefore, take advantage of this positive trend after weighing the pros and cons of the applicability, especially in dealing with sensitive topics like corruption. Also, given the upsurge of big data analytics on almost every topic, conclusive deductions can be drawn with justifiable connotations on the dynamics of corruption in specific projects, and how these practices can be mitigated, and transparency improved via big data analytics.

The second limitation concerns the non-generalization of the study's results. While the main surveys conducted in this study mainly come from Ghana (developing countries) and Hong Kong (developed country), it must be emphasized that using or referring to the outputs generated in this study must be duly acknowledged. Corruption has long been reported to be a complex subject and is defined differently in different contexts (Owusu et al. 2017; Jain 2001). Therefore, generalizing the results of this study beyond Ghana may be somewhat unrealistic. While this study can offer a solid foundation for similar studies in other developing contexts, more general surveys that are evenly distributed across different contexts can be conducted, if possible, to be able to draw general deductions or conclusions from the survey.

Admittedly, the construction process is a highly complex one; however, only the procurement section was examined in this study. Therefore, whereas germane and practical conclusions may be drawn to make significant contributions towards the justification of the adoption of the model developed in this paper in different contexts, it must be noted that the results obtained, and the model developed cannot be generalized to represent the entire construction process. Further studies should consider examining the other stages of the construction process other than the procurement, which has been reported in this study. Moreover, another primary limitation of this study is attributed to the overgeneralization or the applicability of the results to different contexts. Simply put, since the study primarily highlights the case of the Ghanaian context, the adoption of the linear model for estimating the vulnerability indexes of other countries should be conducted with caution as explicated above. Also, per the theory behind the measurement tools for estimating corruption index, Trapnell (2015) revealed two foundational constructs that can be considered to establish more rigorous and explicit results. They are the estimation of corrupt practices and the estimation of anti-corruption measures. This study only focused on the measurement of corruption (i.e., the susceptibility of the procurement stages to the incidence of corrupt practices) and not on anti-corruption measures. Therefore, it is recommended that future studies explore the measurement indexes for anti-corruption measures since such a study will contribute to the holistic measurement or estimation and determination of a firm's or a state's condition regarding corruption.

Regarding the international surveys conducted in this study, the limitation has to do with the unevenness of the respondents' distribution across the representing countries. Although discussions are made on both developed and developing countries, it must be emphasized that the conclusions do not represent the general views of the overall experts from the developed or the developing world because most of the respondents in this study happen to come from Hong Kong and Ghana, respectively. Therefore, any reference to the results should be relayed, conveyed, or used with caution (that is, the specified limitation encountered in this study). The skewness of the data toward these two specific regions is attributed to the fact that the authors are currently conducting a research study using these two contexts as the scopes for the ongoing research. Although the research is still ongoing, the views of other experts,

particularly from the top global organizations and academics involved in the procurement and management of construction and other infrastructure-related projects, were sought after and solicited to determine whether there will be a level of consistency in the views of all the experts involved regardless of their nationality.

Moreover, the findings on the international survey cannot be attributed to one specific country but rather serve as a point of reference in considering areas to tackle in each context regarding the constructs explored at the international level (e.g., explorations on the barriers against the efficacy of ACMs). It is therefore recommended that further detailed research be conducted in a more focused direction (i.e., institution or country-specific). This is because the barriers that affect a given context may be very much disparate from another context, even in the same region. Some items may be more critical than others, and even other barriers specific to one context may be identified to exceed the 17 barriers identified in this study. This is one of the many reasons more detailed studies in specific contexts are needed, but this study can be referred to as a reference point.

It may also be argued that a larger sample from more wide-ranging counties could have generated more significant results. Not disputing this proposition, it is justified that the sample size is adequate and appropriate for further analysis, given the initial results generated by the necessary tests, which stipulate the results to be reliable and appropriate. Moreover, due to the sensitive nature of the topic, and the realization that the theme was focused on a wider perspective, experts were reluctant to share the situations from their specific countries, and only those who responded were recorded for the analysis. However, the authors believe and recommend that researchers who aim to conduct similar research in a given or specific context should solicit more data to eliminate any discrepancies concerning the reliability of the data and yield more significant results.

10.4 Chapter Summary

This chapter presented the summaries of the main aim of the study with the five interrelated objectives developed to realize the aim of the study. The conclusions of all the objectives were presented with their respective significance to the scholarship of corruption-related studies in infrastructure/construction project management. Moreover, the contributions to industry practice and practitioners have been duly stipulated. Finally, the major limitations encountered regarding the project have been presented with recommendations for future research.

APPENDICES

Appendix A

To whom it may concern

Dear Sir/Madam

Invitation to participate in a Doctor of Philosophy (Ph.D.) research on corruption in infrastructure procurement in Ghana

As a practitioner with knowledge in infrastructure procurement in Ghana, you are cordially invited to complete the attached questionnaire for a Ph.D. research entitled "Dynamic Evaluation of Corruption in Public Infrastructure Procurement: A Comparative Study of Emerging and Established Economies." This research is sponsored by The Research Grants Council (RGC) of Hong Kong through Hong Kong Ph.D. Fellowship Scheme and The Hong Kong Polytechnic University's Postgraduate Studentship Scholarship. This research is supervised by Chair Professor Albert P.C. Chan.

This research aims to explore the dynamics of corruption in infrastructure procurement and to develop a comprehensive and best practice framework for thwarting corrupt practices identified in infrastructure procurement, thus, creating a less corrupt or corrupt free procurement process. In realizing the above-stipulated aim, this questionnaire is developed to solicit your views on the forms of corruption, causes of corruption, corruption indicators in the context of Ghana, statutory and corporate anti-corruption measures and lastly barriers to the effective application of anti-corruption measures. All the most influencing variables within the constructs are to be selected based on their level of importance within the infrastructure procurement process of Ghana. It is envisaged that this study will potentially contribute to overall transparency in the national strategic and ethical procurement policies toward sustainable development in the country.

The questionnaire is simple and takes approximately 25 minutes to complete**. Please, there are no wrong or correct answers, only your much-needed opinions.** All your responses will be treated with strict confidentiality and used only for academic purpose.

Please, we understand that this survey will consume some of your precious time, but this research will not be successful without your expert opinions. **Lastly, we would be grateful if you can forward the questionnaire to other professionals, who you know have a wealth of experience or knowledge of the topic.** Many thanks for your kind consideration. For any inquiries, please contact Emmanuel Kingsford Owusu (Tel.: +852-5177 ; and email: emmanuel.k.owusu@ or Ir Professor Albert P.C. Chan (email: albert.chan@).

Your views are valuable to the success of this research. After the research, we are willing to share a summary of the outcomes with practitioners in Ghana and anyone who shows interest.

We would be grateful if you could complete and return the questionnaire to the researchers within **two weeks**. Thank you again for your kind consideration.

Yours sincerely,

……

Emmanuel Kingsford Owusu, Ph.D. Student
Ir Professor Albert P.C. Chan, Head of Department of Building and Real Estate
Chair Professor of Construction Engineering and Management
The Hong Kong Polytechnic University, Hong Kong

Dynamic Evaluation of Corruption in Public Infrastructure Procurement: A Comparative Study of Emerging and Established Economies

Questionnaire Survey

Important instructions:

1. Please, consider your experience in public procurement or construction industry to complete this survey.
2. Use any suitable symbol (such as "√") to indicate your opinions.
3. Please, you have **TWO WEEKS** to complete the questionnaire.
4. Your mobile number: _____and email address: _____
5. For any queries, please contact me via e-mail at: emmanuel.k.owusu@_____

Section A1: Information of Participants (Construction Experts)

1. Your current professional affiliation
   ☐ Public sector ☐ Private sector ☐ Both

2. What is your professional background?
   ☐ Engineer ☐ Quantity Surveyor ☐ Contractor ☐ Architect ☐ Client
   ☐ Academic/researcher ☐ Other please specify____

3. Your working experience in the construction industry?
   ☐ 1-5 years ☐ 6-10 years ☐ 11-20 years ☐ Above 20 years

4. How prevalent is corruption in Ghana's construction industry?
   ☐ Not Prevalent; ☐ Less Prevalent; ☐ Neutral; ☐ Prevalent; ☐ Highly Prevalent

5. Do you know of any anti-corruption framework for the construction industry?
   ☐ Yes; ☐ No; ☐ Not sure

6. If yes, how effective is it/are they?
   ☐ Not Effective; ☐ Less Effective; ☐ Neutral; ☐ Effective; ☐ Highly Effective

1. Current position in organization
   ☐ Director ☐ Senior Manager ☐ Supervisor ☐ Other, please specify____

2. Your working experience in construction procurement sector
   ☐ 1-5 years ☐ 6-10 years ☐ 11-20 years ☐ Above 21 years

3. Please kindly indicate how you have been involved in procurement practices?
   ☐ All stages ☐ Specific stage_____ ☐ Multiple stages

SECTION B

Q1a. Proneness of procurement stages to corruption. How vulnerable are the following stages of procurement and construction to corruption? **1= Not vulnerable to 5=Extremely vulnerable.** Please, also indicate the most extreme **(only one)** associated form to each process. **1= Bribery Acts; 2= Fraudulent Acts; 3= Collusive Acts; 4= Extortionary Acts and 5= Discriminatory Acts**

No	Procurement Process		Level of Vulnerability	Form associated
1	Pre-Contract stage	Define requirements	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
2		Procurement process planning and strategy development	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
3		Pre-tender survey	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
4		Obtaining necessary approvals	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
5		Soliciting tenders	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
6		Receipt of tenders	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
7	Contract Stage	Pre-tender meeting (Establishing Evaluation Criteria, Evaluation Plan, Evaluation Criteria)	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
8		Tender evaluation (review to approve or reject bids)	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
9		Select contractor	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
10		Award contract/Purchase order	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
11		Preparation and Signing of Contract	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
12	Contract administration stage	Issuing contract amendments	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
13		Monitor Progress	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
14		Follow up delivery	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
15		Administer Progress payments	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
16	Post contract phase	File final action Contractor agreement to final claim	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
17		Issue final contract amendment	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
18		Complete of financial audits	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
19		Check for proof of delivery	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
20		Return of performance bonds and close-out	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
21		Ensure completeness and accuracy of file documentation	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
No	Construction Process		Level of Vulnerability	Form associated
1	Conception		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
2	Project selection stage		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
3	Planning stage		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
4	Inspection stage		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
5	Design Stage		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
6	Pre-qualification and tender		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
7	Contact signing stage		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
8	Project execution		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
9	Service Delivery		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
10	Project Maintenance		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
11	Dispute resolution		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
No.	Parties involved in procurement and construction processes		Level of Vulnerability	Level of Corruption
1	Public participants (Clients, regulatory authorities, etc.)		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
2	Private participants (clients, financiers, etc.)		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
3	Contractors and subcontractors		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
4	Design consultant (Architects, Quantity Surveyors, etc.)		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
5	Suppliers		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
6	Legal advisors		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
7	Other		☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5

2. General Forms of corruption in Infrastructure Procurement. How critical are the incidences of the following forms of corruption to infrastructure procurement? **1= Not Critical; 2=Less Critical; 3=Neutral; 4= Critical; 5=Very Critical.** Please, kindly indicate with respect to their categories.

No.	Corruption Acts	Corruption Form	Level of Criticality
			Low ⟺ High
1	Bribery Acts	Bribery	☐1; ☐2; ☐3; ☐4; ☐5
2		Kickbacks	☐1; ☐2; ☐3; ☐4; ☐5
3		Facilitation Payments	☐1; ☐2; ☐3; ☐4; ☐5
4		Influence Peddling	☐1; ☐2; ☐3; ☐4; ☐5
5		Lobbying	☐1; ☐2; ☐3; ☐4; ☐5
6		Solicitation	☐1; ☐2; ☐3; ☐4; ☐5
7	Fraudulent Acts	Fraud	☐1; ☐2; ☐3; ☐4; ☐5
8		Collusion	☐1; ☐2; ☐3; ☐4; ☐5
9		Front/Shell companies	☐1; ☐2; ☐3; ☐4; ☐5
10		Dishonesty	☐1; ☐2; ☐3; ☐4; ☐5
11		Ghosting	☐1; ☐2; ☐3; ☐4; ☐5
12		Money Laundering	☐1; ☐2; ☐3; ☐4; ☐5
13		Deception	☐1; ☐2; ☐3; ☐4; ☐5
14	Collusive Acts	Bid rigging	☐1; ☐2; ☐3; ☐4; ☐5
15		Price fixing	☐1; ☐2; ☐3; ☐4; ☐5
16		Cartels	☐1; ☐2; ☐3; ☐4; ☐5
17	Extortionary Acts	Extortion	☐1; ☐2; ☐3; ☐4; ☐5
18		Client abuse/'clientelism'	☐1; ☐2; ☐3; ☐4; ☐5
19		Intimidations and threats	☐1; ☐2; ☐3; ☐4; ☐5
20		Coercion	☐1; ☐2; ☐3; ☐4; ☐5
21		Blackmail	☐1; ☐2; ☐3; ☐4; ☐5
22	Discriminatory	Nepotism	☐1; ☐2; ☐3; ☐4; ☐5
23	Acts	Favoritism	☐1; ☐2; ☐3; ☐4; ☐5
24		Patronage	☐1; ☐2; ☐3; ☐4; ☐5
25		Guanxi	☐1; ☐2; ☐3; ☐4; ☐5
26	Unclassified Acts	Embezzlement	☐1; ☐2; ☐3; ☐4; ☐5
27		Conflict of interest	☐1; ☐2; ☐3; ☐4; ☐5
28		Professional negligence	☐1; ☐2; ☐3; ☐4; ☐5

Q3. The effectiveness of Anti-Corruption Measures. How effective are the following measures to the application of infrastructure procurement? **1= Not Effective; 2=Less Effective; 3=Neutral; 4= Effective; 5=Very Effective**

No.	Anti-Corruption Measures (ACM)	Level of Effectiveness
		Low ⟺ High
1	Ethical code	☐1; ☐2; ☐3; ☐4; ☐5
2	Transparency mechanism	☐1; ☐2; ☐3; ☐4; ☐5
3	Training and development initiatives	☐1; ☐2; ☐3; ☐4; ☐5
4	Raising awareness	☐1; ☐2; ☐3; ☐4; ☐5
5	Rigorous technical auditing system	☐1; ☐2; ☐3; ☐4; ☐5
6	Contract monitoring	☐1; ☐2; ☐3; ☐4; ☐5
7	Comprehensive rules and regulations	☐1; ☐2; ☐3; ☐4; ☐5
8	Harsh punishment or penalty	☐1; ☐2; ☐3; ☐4; ☐5
9	Whistle-blowing mechanism	☐1; ☐2; ☐3; ☐4; ☐5
10	Compliance to fairness and transparent procedures	☐1; ☐2; ☐3; ☐4; ☐5
11	Education	☐1; ☐2; ☐3; ☐4; ☐5
12	Increase in accountability	☐1; ☐2; ☐3; ☐4; ☐5
13	Access to information	☐1; ☐2; ☐3; ☐4; ☐5
14	Financial disclosure / Disclosure	☐1; ☐2; ☐3; ☐4; ☐5
15	Contractual compliance	☐1; ☐2; ☐3; ☐4; ☐5
16	Good Leadership	☐1; ☐2; ☐3; ☐4; ☐5
17	Professional associations	☐1; ☐2; ☐3; ☐4; ☐5
18	Debarment/ Promoting fair debarment procedures.	☐1; ☐2; ☐3; ☐4; ☐5
19	Procedural compliance	☐1; ☐2; ☐3; ☐4; ☐5
20	Rigorous supervision among others	☐1; ☐2; ☐3; ☐4; ☐5
21	Effective investigation, court proceedings, departmental disciplinary action	☐1; ☐2; ☐3; ☐4; ☐5
22	Development of strong political and ethical will to enforce existing anti-corruption policies and laws	☐1; ☐2; ☐3; ☐4; ☐5
23	Enhance communication	☐1; ☐2; ☐3; ☐4; ☐5
24	Dismissal from employment or other disciplinary action]	☐1; ☐2; ☐3; ☐4; ☐5
25	Efficient reporting system (Independent hotline)	☐1; ☐2; ☐3; ☐4; ☐5
26	Information technology	☐1; ☐2; ☐3; ☐4; ☐5

Q4. Barriers to the effective application of Anti-Corruption Measures (ACM) in Infrastructure Procurement. How risky are the following barriers to effective implementation and application of anti-corruption measures in infrastructure procurement? **Use 1=Not Critical; 2=Less Critical; 3= Neutral; 4= Critical; 5=Highly Critical.**

No.	Barriers to effective application of ACM	Level of Criticality
1	Political and structural barriers	☐1; ☐2; ☐3; ☐4; ☐5
2	Fear of insecurity which includes fear of losing job	☐1; ☐2; ☐3; ☐4; ☐5
3	Fear of losing life	☐1; ☐2; ☐3; ☐4; ☐5
4	Social misrepresentation	☐1; ☐2; ☐3; ☐4; ☐5
5	Fear of being marginalized	☐1; ☐2; ☐3; ☐4; ☐5
6	Fear of being caught reporting	☐1; ☐2; ☐3; ☐4; ☐5
7	Social or occupational stigma and rejection	☐1; ☐2; ☐3; ☐4; ☐5
8	Bureaucratic process of reporting corrupt cases	☐1; ☐2; ☐3; ☐4; ☐5
9	Lack of independence	☐1; ☐2; ☐3; ☐4; ☐5
10	Fear of victimization	☐1; ☐2; ☐3; ☐4; ☐5
11	Inappropriate internal institutional coordination / inter agency relations	☐1; ☐2; ☐3; ☐4; ☐5
12	Perception of no better end result, distrust in system	☐1; ☐2; ☐3; ☐4; ☐5
13	Lack of political will, A lack of political will by government officials and statutory professional councils to fight corruption is seen as an exacerbating factor	☐1; ☐2; ☐3; ☐4; ☐5
14	Lack of understanding and knowledge of their rights within a contractual environment, difficulty in providing concrete evidence	☐1; ☐2; ☐3; ☐4; ☐5
15	Inappropriate staffing	☐1; ☐2; ☐3; ☐4; ☐5
16	Lack of knowledge or non-familiarity with ethical codes/ organizational codes of ethics	☐1; ☐2; ☐3; ☐4; ☐5
17	Personal attitude, for example, lack of will to become involved in fighting corruption	☐1; ☐2; ☐3; ☐4; ☐5
18	*Other*	☐1; ☐2; ☐3; ☐4; ☐5

Q5. Causes of corruption in Infrastructure Procurement. How critical are the following causes to the procurement of infrastructure? **Use 1=Not Critical; 2=Less Critical; 3= Neutral; 4= Critical; 5=Highly Critical.**

No	Causes	Criticality
1	Over close relationships	☐1; ☐2; ☐3; ☐4; ☐5
2	Poor professional ethical standard	☐1; ☐2; ☐3; ☐4; ☐5
3	Lack of a positive industrial climate	☐1; ☐2; ☐3; ☐4; ☐5
4	Negative role models	☐1; ☐2; ☐3; ☐4; ☐5
5	Inadequate sanctions	☐1; ☐2; ☐3; ☐4; ☐5
6	Lack of rigorous supervision	☐1; ☐2; ☐3; ☐4; ☐5
7	Personal greed	☐1; ☐2; ☐3; ☐4; ☐5
8	Flawed regulation system	☐1; ☐2; ☐3; ☐4; ☐5
9	Deficiencies in rules and laws	☐1; ☐2; ☐3; ☐4; ☐5
10	Great project complexity	☐1; ☐2; ☐3; ☐4; ☐5
11	Multifarious licenses or permits	☐1; ☐2; ☐3; ☐4; ☐5
12	Low wage level	☐1; ☐2; ☐3; ☐4; ☐5
13	The nature of infrastructure projects	☐1; ☐2; ☐3; ☐4; ☐5
14	Over competition in tendering process	☐1; ☐2; ☐3; ☐4; ☐5
15	Inappropriate political interference	☐1; ☐2; ☐3; ☐4; ☐5
16	Lack of pro-active steps by funders to limit corruption on projects	☐1; ☐2; ☐3; ☐4; ☐5
17	Absence of effective and responsible administrative systems	☐1; ☐2; ☐3; ☐4; ☐5
18	Insufficient legal punishments and penalties	☐1; ☐2; ☐3; ☐4; ☐5
19	Fierce competition	☐1; ☐2; ☐3; ☐4; ☐5
20	Weak procurement / contractual structures	☐1; ☐2; ☐3; ☐4; ☐5
21	Absence of control mechanism	☐1; ☐2; ☐3; ☐4; ☐5
22	Transition of governments or economies	☐1; ☐2; ☐3; ☐4; ☐5
23	The nature of corruption being a secret activity	☐1; ☐2; ☐3; ☐4; ☐5
24	Complex contractual structure	☐1; ☐2; ☐3; ☐4; ☐5
25	Appointment of a local representative who acts on behalf of the firm to obtain contracts	☐1; ☐2; ☐3; ☐4; ☐5
26	Economic survival	☐1; ☐2; ☐3; ☐4; ☐5
27	Delaying the payment of workers' salaries	☐1; ☐2; ☐3; ☐4; ☐5
28	Lack of legal awareness	☐1; ☐2; ☐3; ☐4; ☐5
29	Lack of coordination among Government departments	☐1; ☐2; ☐3; ☐4; ☐5
30	Poor documentation of records	☐1; ☐2; ☐3; ☐4; ☐5
31	Insufficient transparency in the selection criteria for tenderers	☐1; ☐2; ☐3; ☐4; ☐5
32	Deregulation in the public construction	☐1; ☐2; ☐3; ☐4; ☐5
33	Complexities of institutional roles and functions	☐1; ☐2; ☐3; ☐4; ☐5
34	Asymmetric information amongst project parties	☐1; ☐2; ☐3; ☐4; ☐5
35	Lack of standardized execution in construction projects	☐1; ☐2; ☐3; ☐4; ☐5
36	Negative encouragement	☐1; ☐2; ☐3; ☐4; ☐5
37	(The influence of guanxi)	☐1; ☐2; ☐3; ☐4; ☐5
38	Absence of project anti-corruption systems	☐1; ☐2; ☐3; ☐4; ☐5
39	Subjecting workers to job insecurity, especially in government and public enterprises	☐1; ☐2; ☐3; ☐4; ☐5
40	Feeble semblance of public interest	☐1; ☐2; ☐3; ☐4; ☐5
41	Monopoly	☐1; ☐2; ☐3; ☐4; ☐5
42	Inefficiency	☐1; ☐2; ☐3; ☐4; ☐5
44	Lack of frequency of projects	☐1; ☐2; ☐3; ☐4; ☐5

SECTION C

Q1. Procurement and Contractual Irregularities in the Ghanaian Public Sector. How probable are the listed irregularities likely to happen and should they occur in infrastructure procurement, how severe are their impact on the procurement process? **Use 1=Not Probable; 2=Less Probable; 3= Neutral; 4= Probable; 5=Highly Probable; at the probability section and 1=Not Severe; 2= Less Severe; 3= Neutral; 4= Severe; 5= Very Severe** at the Severity Section.

No	Procurement Irregularities/Vulnerabilities	Probability	Severity
1	Institutions not following correctly the Public Procurement Act in terms of obtaining minimum quotations, exceeding authorized threshold limits and unauthorized sole sourcing of suppliers.	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
2	Lack of adequate supervisory control over procurement transactions and management	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
3	Payments for uncompleted works	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
4	Non-application of sanctions	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
5	Poor supervision of subordinate officers	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
6	Disregard for Public Procurement Act regulations	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
7	Procurements not taken on ledger charge	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
8	The procurement of goods and services by management without adequate recourse to procurements committees of the various public institutions, which diverges from the provided regulations.	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
9	Variations to contract	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
10	Outstanding mobilization advances owing to non-observance of stipulated regulations	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
11	Fragmentary procurement	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
12	Little evidence of value for moneys spent	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
13	Sourcing of proforma invoices from the same supplier (Single sourcing)	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
14	Overpayment of purchases	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
15	Lack of proper co-ordination among key departments of the Company and apparent internal control weaknesses reconciliation on Association	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
16	Lack of consistent monitoring and review of procurement activities	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
17	Lack of whole-of-government and corporate procurement planning for significant purchases	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5
18	Lack of audit trails or verification data	☐1; ☐2; ☐3; ☐4; ☐5	☐1; ☐2; ☐3; ☐4; ☐5

Please, if you would like to receive a summary of the research findings, kindly provide your email address.

Please, enter your email address_____

-The end-

Please, thank you for participation

Definition of key terms
(Please, if necessary, refer to the following definitions when answering the questions in section C)

Forms	Description
F1	***Bribery Acts***
Bribery	Bribery refers to a corrupt act which may involve giving, promising, soliciting, accepting or offering a benefit to lure or entice someone to act unethically or illegally.
Kickbacks	Kickbacks refer to illegal acts where a secret payment is demanded by an individual in a coercive position from another party in search of an advantageous or a biased decision.
Facilitation Payments	Facilitation Payments are regarded as small bribes which can also be termed as 'grease' or 'speed' payments normally made to expedite or secure an action to which the briber already has authorized or other rights to.
Influence Peddling	Influence Peddling is described as the use of one's status or influence on behalf of another person for a special advantage in return for financial favors or other benefits.
Lobbying	Lobbying refers to any corrupt act which is undertaken to influence the decisions and policies of an institution to favor an outcome or a course.
Solicitation	Solicitation is the act of enticing, ordering, influencing or asking another party to indulge in the act of bribery or other corrupt behaviors.
F2	***Fraudulent Acts***
Fraud	This takes place when a party deceives another fellow with the aim of gaining an illegal or unfair advantage (contract award, financial, political).
Collusion	Collusion is regarded as an undisclosed arrangement that exists among the parties involved, either in the private or public sector or both who meet to conspire to commit deceitful or fraudulent acts with the intention of gaining illegitimate rewards such as financial gains.
Front/Shell companies	Front/ Shell companies refer limited liability companies or corporations which have no corporal existence in terms of jurisdiction; no commercial activities neither are they made up of any real employees.
Dishonesty	Dishonesty can be described as an act of lying, stealing or cheating with the primary aim of acquiring, converting or disposing of either tangible or intangible property to obtain an upper hand or a benefit.
Ghosting	Ghosting refers to an entity (either an individual or a unit) made-up for the purposes of fraudulent act or deception.
Money Laundering	Money Laundering refers to the act of concealing the ownership, source or the end point of money obtained in an unlawful of a dishonest manner and secretly placing it in legitimate ventures or projects to make them look lawful.
Deception	Deception refers to the act of presenting wrong information with the aim of misleading another person concerning a situation that in itself is true.
F3	***Collusive Acts***
Bid rigging	Bid rigging refers to a collusive act where consenting participants settle on the results of a bid process beforehand.
Price fixing	Price fixing is a collusive act analogous to big rigging. With this act, a sect of competitors or tenderers colludes to either manipulate or fix prices rather than observe an open market competition.
Cartels	Cartel, also regarded as a form of the collusive act and similar to bid rigging, transpires when two or more firms arrange or enter into an agreement to limit the flow of materials or as fix the prices of goods they control in a specific industry.
F4	***Extortionary Acts***
Extortion	Extortion refers to the direct or indirect act of using one's power, knowledge or status to coercively threaten others in the form of demanding unmerited benefits, compensations or benefits.

Client Abuse/clientelism'	Client Abuse / 'clientelism' refers to a biased arrangement of exchanging goods, favors or resources on a manipulative affiliation between a powerful party and a punier client.
Intimidations and threats	Intimidations and threats are regarded as a form of extortion where an individual intentionally induces a sense of subjection, inferiority or fear into another person or group of individuals with the aim of frightening them to make them do what the Intimidator wants.
Coercion	Coercion is regarded as a direct or indirect act of committing harm, prejudice or threats to negatively influence the actions of another person always often to favor the coercer.
Blackmail	Blackmail can be described as a condition or an act when a party threatens another party if the latter party does not render some sort of privilege.
F5	***Discriminatory Acts***
Nepotism	Nepotism refers to an act where an individual in a position grants a favor to either a relative or a friend without suitable regard to qualification.
Favouritism	Favoritism refers to the act of offering a special treatment to either an individual or a group of persons, and it often takes the form of awarding contract, honoring, hiring, benefits, etc. even though the person may not necessarily be qualified for the position or the contract offered.
Patronage	Patronage is regarded as a form of favoritism where an individual is offered a job, award contract or other benefits regardless his/her entitlement or qualifications and it is normally due to either the individual's connections or affiliations.
Guanxi	Guanxi is a Chinese term for nepotism although not all Guanxi may be termed unlawful. In some cases, it turns to favor the parties that have good connections in a local domain, but it becomes unlawful when the favor is granted to a party or group of persons not deserving the favor.
F6	***Unclassified Acts***
Embezzlement	Embezzlement refers to an act where an individual misappropriates, traffics or uses either goods or funds of an organization or an institution entrusted in his/her care for personal benefits.
Conflict of interest	Conflict of Interest in the construction industry refers to the situation where a professional of the industry is challenged with a choice of deciding between the demands and duties required by profession and their respective personal interests.
Professional negligence	Professional Negligence was insinuated as a corrupt conduct in the construction industry which occurs when a professional fails to provide a responsibility of care which a normal careful and prudent professional would offer given the same conditions.
Reference: Chan and Owusu 2017	

Appendix B

SELECTED JOURNAL PAPERS ON FORMS OF CORRUPTION

Selected papers on Corruption Forms

No.	Journal	Year	Authors	Citation
1	BRI	2004	Dorée, A. G.	107
2	JCEM	2014	Le, Y., Shan, M., Chan, A. P., & Hu, Y.	13
3	JCEM	2012	Meduri, S. S., & Annamalai, T. R.	14
4	JCEM	2012	Ho, C. M.	10
5	JCEM	2000	Wang, S. Q., Tiong, R. L., Ting, S. K., & Ashley, D.	147
6	JCEM	2006	Waara, F., & Bröchner, J.	94
7	JCEM	2008	Sohail, M., & Cavill, S.	57
8	JCEM	2009	Tsai, J. S., & Chi, C. S.	36
9	CME	2011	Tabish, S. Z. S., & Jha, K. N.	25
10	CME	1997	Adams, O.	71
11	CME	2012	Bowen, P. A., Edwards, P. J., & Cattell, K.	23
12	CME	2012	Ling, F. Y. Y., & Tran, P. Q.	19
13	CME	2007	Bowen, P., Akintoye, A., Pearl, R., & Edwards, P. J.	54
14	CME	2011	Tabish, S. Z. S., & Jha, K. N.	37
15	CME	2012	Tabish, S. Z. S., & Jha, K. N.	12
16	ECAM	2016	Loosemore, M., & Lim, B. T. H.	-
17	ECAM	2016	Willar, D., Trigunarsyah, B., & Coffey, V.	1
18	ECAM	2015	Brown, J., & Loosemore, M.	2
19	ECAM	2014	Wibowo, A., & Wilhelm Alfen, H.	6
20	ECAM	2013	Weisheng, L., MM Liu, A., Hongdi, W., & Zhongbing, W.	14
21	ECAM	2004	Liu, A. M., Fellows, R., & Ng, J.	38
22	ECAM	2011	Ke, Y., Wang, S., Chan, A. P., & Cheung, E.	38
23	ECAM	2007	Man-Fong Ho, C.	24
24	IJPM	2009	Sichombo, B., Muya, M., Shakantu, W., & Kaliba, C.	21
25	IJPM	2010	Corvellec, H., & Macheridis, N.	21
26	IJPM	2013	Hwang, B. G., Zhao, X., & Gay, M. J. S.	67
27	IJPM	2015	Zeng, S. X., Ma, H. Y., Lin, H., Zeng, R. C., & Tam, V.	7
28	IJPM	1995	Zhi, H.	333
29	IJPM	1987	Stuckenbruck, L. C., & Zomorrodian, A.	33
30	JME	2012	Olawale, Y., & Sun, M.	11
31	JME	2005	Xu, T., Smith, N. J., & Bower, D. A.	32
32	JME	2014	Le, Y., Shan, M., Chan, A. P., & Hu, Y.	10
33	JME	2016	Zhang, B., Le, Y., Xia, B., & Skitmore, M.	-
34	LME	2009	Stansbury, C.	3
35	LME	2009	Hartley, R.	6
36	LME	2009	Smith, J. H.	2
37	LME	2009	de Jong, M., Henry, W. P., & Stansbury, N.	20
38	PICE-CE	2012	Kenny, C.	2
39	SP*	2016	Transparency International	-

Appendix C

SELECTED JOURNAL PAPERS ON CAUSES OF CORRUPTION

Appendix E: Selected Papers with associated journals (Causes of Corruption)

No.	Journal	Year	Authors	Citation
1	JCEM	2005	Zhang, X	116
2	JCEM	2009	Iyer, K. C., & Sagheer, M.	85
3	JCEM	2014	Le, Y., Shan, M., Chan, A. P., & Hu, Y.	13
4	CME	2012	Ling, F. Y. Y., & Tran, P. Q.	21
5	CME	2004	Yow Thim, L. A. M., & Zonggui, C.	46
6	ECAM	2015	Brown, J., & Loosemore, M.	2
7	IJPM	2014	Ning, Y.	10
8	IJPM	2014	Ling, F. Y. Y., Ong, S. Y., Ke, Y., Wang, S., & Zou, P.	22
9	IJPM	1987	Stuckenbruck, L. C., & Zomorrodian, A.	33
10	CME	2008	Sohail, M., & Cavill, S.	61
11	CME	2012	Bowen, P. A., Edwards, P. J., & Cattell, K.	26
12	CME	2011	Tabish, S. Z. S., & Jha, K. N.	28
13	BRI	2000	Bologna, R., & Del Nord, R.	20
14	BRI	2004	Dorée, A. G.	107
15	JME	2003	Chan, A. P., Chan, D. W., & Ho, K. S.	131
16	JME	2016	Zhang, B., Le, Y., Xia, B., & Skitmore, M.	-
17	JME	2014	Le, Y., Shan, M., Chan, A. P., & Hu, Y.	11
18	IMF*	1998	Tanzi, V.	2061
19	ECAM	2004	Liu, A. M., Fellows, R., & Ng, J.	38
20	CME	2008	Moodley, K., Smith, N., & Preece, C. N.	50
21	CME	2000	Zarkada-Fraser, A., & Skitmore, M.	68
22	PIEEP	2007	Alutu, O. E.	12
23	PIEEP	1993	Porter, J. C.	1
24	PIEEP	2016	Shan, M., Chan, A. P., Le, Y., Hu, Y., & Xia, B.	-
25	PIEEP	1983	Damit, A. P.	-
26	PIEEP	2008	King, W. S., Duan, L., Chen, W. F., & Pan, C. L.	9
27	PIEEP	2009	Fan, L. C., & Fox, P. W.	21
28	PIEEP	2015	Shan, M., Chan, A. P., Le, Y., Xia, B., & Hu, Y.	7
29	LME	2009	Boyd, J. M., & Padilla, J. D.	4
30	LME	2009	Hartley, R.	7
31	LME	2009	de Jong, M., Henry, W. P., & Stansbury, N.	21
32	LME	2009	Krishnan, C.	10
33	LME	2009	Stansbury, N.	1
34	IJPM	2016	Locatelli, G., Mariani, G., Sainati, T., & Greco, M.	-

Appendix D

SELECTED JOURNAL PAPERS ON ANTI-CORRUPTION MEASURES

Appendix F

No.	Journal	Year	Authors	Citation
1	JME	2014	Le, Y., Shan, M., Chan, A., and Hu, Y.	10
2	JCEM	2014	Le, Y., Shan, M., Chan, A. P., & Hu, Y.	12
3	JME	2016	Zhang, B., Le, Y., Xia, B., & Skitmore, M	0
4	CME	2012	Bowen, P. A., Edwards, P. J., & Cattell, K.	23
5	CME	2012	Tabish, S. Z. S., & Jha, K. N.	12
6	CME	2011	Tabish, S. Z. S., & Jha, K. N.	25
7	CME	2008	Sohail, M., & Cavill, S.	59
8	JCEM	2012	Valdes-Vasquez, R., & Klotz, L. E.	56
9	JCEM	2012	Ho, C. M.	9
10	JCEM	1998	Shen, L., & Song, W.	56
11	LME	2009	Hartley, R.	6
12	LME	2009	Krishnan, C.	10
13	LME	2009	Boyd, J. M., & Padilla, J. D.	4
14	PICE-CE	2006	Sohail, M., and Cavill, S.	5
15	PICE-CE	2012	Kenny, C.	2
16	IJPM	2009	Sichombo, B., Muya, M., Shakantu, W., & Kaliba, C.	21
17	JME	2011	Rebeiz, K. S.	27
18	PICE-CE	2012	Hawkins, J., & McKittrick, B.	3
19	LME	2009	de Jong, M., Henry, W. P., & Stansbury, N.	19
20	LME	2009	Stansbury, C.	3
21	LME	2009	Stansbury, N.	1
22	CME	2007	Bowen, P., Akintoye, A., Pearl, R., & Edwards, P. J.	54
23	JCDC (SP)*	2006	Zou, P. X	27
24	SP	1998	Tanzi, V.	1991
25	SP	2002	Søreide, T.	25
26	IJPM	2007	Suen, H., Cheung, S. O., & Mondejar, R.	53
27	LME	2009	Tashjian L	0
28	IJPM	2014	Ling, F. Y. Y., Ong, S. Y., Ke, Y., Wang, S., & Zou, P.	20
29	ECAM	2015	Brown, J., & Loosemore, M.	2
30	PIEEP	1993	Porter, J. C.	1
31	PIEEP	2007	Alutu, O. E.	12
32	PIEEP	2008	King, W. S., Duan, L., Chen, W. F., & Pan, C. L.	9
33	CE	2006	Powell, S.	5
34	CE	2006	Shakantu, W.	30

Appendix E

SELECTED JOURNAL PAPERS ON HONG KONG

Appendix: Selected papers with their corresponding journals

No	Year	Journal	Authors	Citation
	1995	IJPA	Shafiqul Huque, A.	3
	1995	CJWB	Lee, M. Q.	14
	1997	JFC	Bishop, Mike	2
	1999	TOC	Lo, T. W.	1
	1999	JCC	Moran, J.	9
	1999	BEQ	Snell, R. S.	45
	1999	JBE	Snell, R. S., Chak, A. M. K., & Chu, J. W. H.	44
	2000	PJM	Snell, R. S., & Herndon Jr, N. C	40
	2001	JCCM	Lo, J. M.	11
	2001	JCE	Mo, P. H.	840
	2003	WSP	Kim, T.	11
	2004	GER	Li, S.	1
	2007	PAD	Marquette, H.	12
	2008	RPAM	Cheung, A. B.	8
	2008	JBE	Donleavy, G. D., Lam, K. C. J., & Ho, S. S.	18
	2008	CLSC	Lo, T. W., & Ngan, P.	2
	2009	JFC	Young, S. N.	8
	2010	APR	De Speville, B.	16
	2010	JBE	Ho, C., & Redfern, K. A.	55
	2010	AJC	Jiao, A. Y.	5
	2010	SAPM	Wong, W.	-
	2011	CUP	Donald, D. C.	-
	2012	PPM	Luk, S. C. Y.	11
	2012	OUP	Raj Kumar, C.	-
	2012	LSC	Scott, I., & Leung, J. Y	19
	2013	JHG	Chu, C.	2
	2013	SIR	Gong, T., & Wang, S	22
	2013	APJM	Mao, Y., Wong, C. S., & Peng, K. Z	5
	2013	RPP	Quah, J. S.	4
	2013	PPAM	Scott, I.	3
	2013	JCC	Scott, I.	14
	2013	CI	Yep, R.	5
	2014	JCCA	Lin, M. W., & Yu, C.	9
	2015	IPMJ	Gong, T., Wang, S., & Ren, J.	3
	2015	AJPS	Holmes, L.	-
	2015	CPE	Ip, E. C.	-
	2015	CUP	Jones, C. A. G.	-
	2015	JFC	Michael, B.	-
	2015	SB	Scott, I.	-
	2015	AE	Weng, W. W., Woo, C. K., Cheng, Y. S., Ho, T., & Horowitz, I.	2
	2016	JDS	Hira, A	2
	2016	CCR	Lee, M. H., & Lio, M. C.	-
	2016	CLSC	Li, L.	1
	2016	AG	Warf, B.	-

Appendix F

Table 2: Information on selected papers

No.	Journal/Publisher	Year	Authors	Type of study	No. of respondents	Study context	Methodology
1	JME, ASCE	2017	Ameyaw, E. E., Pärn, E., Chan, A. P., Owusu-Manu, D. G., Edwards, D. J., & Darko, A.	Empirical	35	Ghana	Descriptive (Mean Scores and Frequency), purposive
2	CME, Taylor and Francis	2011	Tabish, S. Z. S., & Jha, K. N	Empirical	6	India	Delphi approach Descriptive (Mean Scores and Frequency), purposive
3	IJPM, Elsevier	2017	Locatelli, G., Mariani, G., Sainati, T., & Greco, M.	Review study	-	Italy	Case analysis
4	SEE, Springer	2017	Owusu, E. K., Chan, A. P., & Shan, M.	Review study	-	International	Content and thematic analysis.
5	JCEM, ASCE	2017	Chan, A. P., & Owusu, E. K.		-	International	Content and thematic analysis.
6	CME, Taylor and Francis	2007	Bowen, P., Edwards, P., & Cattell, K.	Empirical study	107 out of 193 through a stratified random sampling	South Africa	Frequency with respective percentages and descriptive
7	JCDC	2006	Zou, P. X.	Empirical	14	China	Qualitative analysis, focus-group workshops and face-to-face interviews
8	JME, ASCE	2014	Le, Y., Shan, M., Chan, A. P., & Hu, Y.	Review study	-	International	Document/content analysis.
9	JPIEEP, ASCE	1992	Porter, J. C.	Review study	-	International	Document/content analysis
10	CME, Taylor and Francis	2012	Bowen, P. A., Edwards, P. J., & Cattell, K. (2012)	Empirical study	493 out of 11,608 (Random Sampling)	South African	Qualitative: Thematic analysis
11	JCEM, ASCE	2009	Iyer, K. C., & Sagheer, M. (2009	Empirical Study	4	India	Interpretative Structural Modeling analysis after purposive sampling.
12	LME, ASCE	2009	Stansbury, N. (2009).	Review study	-	The United Kingdom	Review
13	IJMPB, Emerald	2010	Osei-Tutu, E., Badu, E., & Owusu-Manu, D. (2010).	Review Study	-	Ghana	Case with Document/content analysis
14	SEE, Springer	2015	Shan, M., Chan, A. P., Le, Y., & Hu, Y. (2015a)	Empirical Study	188	China	Factor analysis and partial Least squares-structural equation modeling

15	SEE, Springer	2017	Shan, M., Le, Y., Yiu, K. T., Chan, A. P., & Hu, Y. (2017).	Empirical Study	188	China	Factor analysis and partial Least squares-structural equation modeling
16	JCEM, ASCE	2008	Sohail, M., & Cavill, S. (2008).	Review Study	-	International	Reports review Document/content analysis
17	LME, ASCE	2009	Krishnan, C. (2009).	Review Study	-	International	Case reports
18	AA, Wiley	2013	Tidey, S. (2013)	Review Study	-	Indonesia	Document/content analysis
19	JPIEEP, ASCE	2009	Alutu, O. E. (2007).	Empirical study	200 out of 760 (Random Sampling)	Nigeria	Frequency with respective percentages and descriptive

Notes: Full references are found in the referencing list. Abbreviations are listed as follows: JME - Journal of Management in Engineering; ASCE - American Society of Civil Engineers; CME - Construction Engineering and Management; IJPM - International Journal of project management; SEE - Science and engineering ethics; JCEM - Journal of construction engineering and management; JCDC - Journal of construction in Developing Countries; JPIEEP - Journal of Professional Issues in Engineering Education and Practice; LME - Leadership and Management in Engineering; IJMPB - International Journal of Managing Projects in Business; AA - American Anthropologist.

Appendix G

SELECTED REPORTS ON GHANA PUBLIC AUDIT

The Public Accounts of Ghana Ministries, Departments and Other Agencies (MDAs)

GHANA

Reports References

1. Ghana Audit Service, GAS (2005a). Report of the Auditor-General on the Public Accounts of Ghana Ministries, Departments and other Agencies (MDAs) for the Financial Year Ended 31 December 2005 (For 2005 and 2004), available at: www.ghaudit.org/gas/site/reports/download_report/475, (accessed 2 December 2016)
2. Ghana Audit Service, GAS (2005b). Report 0f the Auditor-General on the Public Accounts of Ghana – Public Boards, Corporations and other Statutory Institutions for the Period Ended 31 December 2005, available at: www.ghaudit.org/gas/site/reports/download_report/436, (accessed 4 December 2016)
3. Ghana Audit Service, GAS (2006a). Report of the Auditor-General on the Public Accounts of Ghana Ministries, Departments and other Agencies (MDAs) for the Financial Year Ended 31 December 2006, available at: www.ghaudit.org/gas/site/reports/download_report/437, (accessed 9 December 2016)
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Appendix H

Questionnaire Validation for the Transparency Constructs in Infrastructure Procurement

Purpose of Questionnaire

This questionnaire is formulated to validate the set of (i) 38 causal factors of corruption, (ii) 18 procurement irregularities, (iii) 21 contractual Irregularities, (iv) 27 Forms of corruption, (iv) 26 Anti-corruption measures and (v) 17 barriers against the effectiveness of anti-corruption measures in infrastructure procurement.

The variables captured under the constructs listed above were established as part of the deliverables of a PhD research study conducted by Mr. Emmanuel Kingsford Owusu, a doctoral fellow at the Hong Kong Polytechnic University under the noble supervision of Professor Albert P.C. Chan. The overall study aimed at assessing the dynamism of the constructs of corruption in infrastructure procurement in both the developing and the developed regions using Ghana and Hong Kong as the respective case studies. All the variables were derived from comprehensive review studies, pilot tests and an expert survey conducted between June 2017 – December 2017 via online, face-to-face and snowball approach.

Instruction

This document has 12 pages (page 1 presenting the background and 9 pages presenting the various constructs under investigation in in separate tables). After examining the tables, you are kindly requested to respond to follow-up questions underneath each construct aimed at validating the factor list provided under each construct.

Information of expert respondents

Name of organization/Institution:
Position in organization:
Primary role:
Years of professional experience:

Please, we understand that this exercise will consume some of your precious time, but this research will not be successful without your expert opinions. Many thanks for your kind consideration. For any inquiries, please contact Emmanuel Kingsford Owusu (Tel.: +852-5177 ; and email: emmanuel.k.owusu@. or Ir Professor Albert P.C. Chan (email: albert.chan@).

We would be grateful if you could complete and return the questionnaire to the researchers on or before 27 June 2018. Thank you again for your kind consideration.

Yours sincerely,

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Emmanuel Kingsford Owusu, Ph.D. Student
Ir Professor Albert P.C. Chan, Head of Department of Building and Real Estate
Chair Professor of Construction Engineering and Management
The Hong Kong Polytechnic University, Hong Kong

Part A: Procurement Irregularities Factors in Public Infrastructure Procurement

Table 1: Established variables for Procurement Irregularities

Code	Procurement Irregularities	P-M	S-M	Sig. I	Impact	N-V	Rank	Criticality
PI-1	Payments for uncompleted works	3.85	3.84	14.78	3.84*	1.00	1	High
PI-2	Sourcing of proforma invoices from the same supplier (single sourcing)	3.87	3.77	14.59	3.82*	0.96	2	High
PI-3	Lack of proper co-ordination among key departments of the company and apparent internal control weaknesses reconciliation on Association	3.73	3.68	13.73	3.70*	0.75	3	High
PI-4	Institution not following correctly the public procurement Acts in terms of obtaining minimum quotations, exceeding authorization threshold limits and unauthorized sole sourcing of suppliers	3.58	3.66	13.10	3.62*	0.61	4	High
PI-5	The procurement of goods and services by management without adequate resources to procurements committee of the various public institutions, which diverges from the provided regulations	3.47	3.69	12.80	3.58*	0.54	5	High
PI-6	Disregard for public procurement Acts regulations	3.65	3.48	12.70	3.56*	0.51	6	High
PI-7	Lack of consistent monitoring and review of procurement activities	3.66	3.45	12.63	3.55*	0.49	7	High
PI-8	Non-application of sanctions	3.61	3.48	12.56	3.54*	0.47	8	High
PI-9	Poor supervision of subordinate officers	3.56	3.48	12.39	3.52*	0.44	9	High
PI-10	Lack of whole-of-government and corporate procurement planning for significant purchases	3.50	3.48	12.18	3.49*	0.39	10	High
PI-11	Procurement not taken on ledger charge	3.63	3.31	12.02	3.47*	0.35	11	High
PI-12	Overpayment of purchases	3.58	3.35	11.99	3.46*	0.33	12	High
PI-13	Variations to contract	3.45	3.39	11.70	3.42	0.26	13	Moderate
PI-14	Little evidence of value for moneys spent	3.56	3.27	11.64	3.41	0.25	14	Moderate
PI-15	Lack of audit trails or verification data	3.52	3.31	11.65	3.41	0.25	15	Moderate
PI-16	Lack of adequate supervisory control over procurement transactions and management	3.39	3.44	11.66	3.41	0.25	16	Moderate
PI-17	Fragmentary procurement	3.32	3.48	11.55	3.40	0.23	17	Moderate
PI-18	Outstanding Mobilization advances owing to non-observance of stipulated regulations	3.18	3.37	10.72	3.27	0.00	18	Moderate
		5 - point scale; 1 = not critical and 5 = very						

Risk significance index (Sig. I) = probability mean (P-M) × severity mean (S-M)
Risk impact = (risk significance index)$^{0.5}$
N-V: Normalization (N) value = (actual mean-minimum mean)/(maximum mean-minimum mean)

Table 2: Variables for Contractual Irregularities

Code	Contractual Irregularities	P-Mean	S-Mean	Sig. I	Impact	N-V	Rank	Criticality
CI-1	Absence of transparency in the disbursement of funds and award of contracts	3.64	3.64	13.25	3.64*	1.00	1	High
CI-2	Delay in construction	3.51	3.67	12.88	3.59*	0.95	2	High
CI-3	Failure on the part of public enterprises to award contracts to competent contractors	3.66	3.52	12.88	3.59*	0.95	2	High
CI-4	Delayed execution of contract works	3.56	3.61	12.85	3.58*	0.94	4	High
CI-5	Ineffective control over contracts	3.56	3.41	12.14	3.48*	0.83	5	High
CI-6	Failure to exercise due diligence in the award of contracts	3.55	3.40	12.07	3.47*	0.82	6	High
CI-7	Unsettled mobilization fee due on abandoned	3.58	3.34	11.96	3.46*	0.81	7	High
CI-8	Contract lapses include non-tendering of contracts and items paid for but not supplied	3.52	3.41	12.00	3.46*	0.81	7	High
CI-9	Contract management loopholes	3.47	3.29	11.42	3.38	0.72	9	Moderate
CI-10	Payments for work not certified	3.27	3.31	10.82	3.29	0.63	10	Moderate
CI-11	Outstanding refund of mobilization advances	3.32	3.26	10.82	3.29	0.63	10	Moderate
CI-12	Unexecuted contracts	3.26	3.18	10.37	3.22	0.55	12	Moderate
CI-13	Non-specification of the mode of payment and deliveries in contract agreements	3.36	3.08	10.35	3.22	0.55	12	Moderate
CI-14	Inadequate supporting documents for contract payments	3.19	3.18	10.14	3.18	0.51	14	Moderate
CI-15	Failure to comply with tendering procedures	3.29	3.03	9.97	3.16	0.49	15	Moderate
CI-16	Discrepancies of conditions of contract owing to disregards for stipulated procedures	2.98	3.36	10.01	3.16	0.49	15	Moderate
CI-17	Unapproved contracts	3.16	3.03	9.57	3.09	0.41	17	Moderate
CI-18	Noncompliance to public procurement Acts (2003)	3.11	3.10	9.64	3.10	0.43	18	Moderate
CI-19	Overpayment of contract sum	3.13	3.03	9.48	3.08	0.40	19	Moderate
CI-20	Absence of the signing of contract agreements	2.87	3.02	8.67	2.94	0.26	20	Moderate
CI-21	Failure to retain 10%contract retention funds	2.65	2.76	7.31	2.70	0.00	21	Moderate
5 - point scale		1 = not critical and 5 = very						

VALIDATION QUESTIONNAIRE

Please, kindly respond to separate questions on both contractual and procurement irregularities as presented in the following page sections.

Questionnaire for Part A: Irregularities in Public Infrastructure Procurement

1. Please, kindly choose the suitable score for each validation aspect/question to indicate the extent of your satisfaction: **1 – Poor; 2 – Average; 3 – Good; 4 – Very good; 5 – Excellent.**

No.	Validation Questions ***(on Procurement Irregularities)***	Evaluation Scale
1	Are the 18 procurement irregularities established, critical in the Ghanaian infrastructure procurement?	☐1; ☐2; ☐3; ☐4; ☐5
2	Do the 18 procurement irregularities obscure the normal process of infrastructure procurement in Ghana?	☐1; ☐2; ☐3; ☐4; ☐5
3	Can the 18 procurement irregularities established contribute or create room for corruption to occur?	☐1; ☐2; ☐3; ☐4; ☐5
4	Can the impact of their criticalities have adverse effects on the general economy?	☐1; ☐2; ☐3; ☐4; ☐5
5	Are the probability and severity rankings of the identified irregularities reasonable?	☐1; ☐2; ☐3; ☐4; ☐5

No.	Validation Questions ***(on Contractual Irregularities)***	Evaluation Scale
1	Are the 21 contractual irregularities established, critical in the Ghanaian infrastructure procurement?	☐1; ☐2; ☐3; ☐4; ☐5
2	Do the 21 contractual irregularities obscure the normal process of infrastructure procurement in Ghana?	☐1; ☐2; ☐3; ☐4; ☐5
3	Can the 21 contractual irregularities established contribute or create room for corruption to occur?	☐1; ☐2; ☐3; ☐4; ☐5
4	Can the impact of their criticalities have adverse effects on the general economy?	☐1; ☐2; ☐3; ☐4; ☐5
5	Are the probability and severity rankings of the identified irregularities reasonable?	☐1; ☐2; ☐3; ☐4; ☐5

2. Among the listed 18 procurement and 21 contractual irregularities, which 6 can of each construct can contribute most to the obscurity of the procurement process and as well render the process vulnerable to the incidence of corrupt practice?

Rank	***Procurement Irregularity*** ID (e.g., PIR2)	Rank	***Contractual Irregularity*** ID (e.g., CIR2)
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	

3. Other comment (general or specific)

Part B: Forms and Causes of Corruption in Public Infrastructure Procurement

1. Please, kindly choose the suitable score for each validation aspect/question to indicate the extent of your satisfaction: **1 – Poor; 2 – Average; 3 – Good; 4 – Very good; 5 – Excellent.**

Table 3: Forms of Corruption in the Ghanaian Procurement Public Sector

Code	Variables	Mean	N-Value	Sig	Rank	Criticality
CF1	Bribery	4.02	1.00	0.000	1	High
CF2	Lobbying	3.81	0.76	0.000	2	High
CF3	Price fixing	3.81	0.76	0.000	3	High
CF4	Facilitation payments	3.79	0.74	0.000	4	High
CF5	Bid rigging	3.76	0.70	0.000	5	High
CF6	Conflict of interest	3.74	0.68	0.000	6	High
CF7	Kickbacks	3.74	0.68	0.000	7	High
CF8	Favoritism	3.68	0.61	0.000	8	High
CF9	Solicitation	3.66	0.59	0.000	9	High
CF10	Influence peddling	3.65	0.57	0.000	10	High
CF11	Front/shell companies	3.63	0.55	0.000	11	High
CF12	Embezzlement	3.61	0.53	0.000	12	High
CF13	Nepotism	3.58	0.49	0.000	13	High
CF14	Collusion	3.58	0.49	0.000	14	High
CF15	Fraud	3.53	0.44	0.003	15	High
CF16	Professional negligence	3.52	0.43	0.004	16	High
CF17	Ghosting	3.52	0.43	0.001	17	High
CF18	Dishonesty	3.44	0.33	0.007	18	Moderate
CF19	Patronage	3.44	0.33	0.007	19	Moderate
CF20	Deception	3.37	0.25	0.020	20	Moderate
CF21	Coercion	3.34	0.22	0.047	21	Moderate
CF22	Blackmail	3.29	0.16	0.086	22	Moderate
CF23	Money laundering	3.27	0.14	0.129	23	Moderate
CF24	Cartels	3.26	0.13	0.081	24	Moderate
CF25	Extortion	3.24	0.10	0.125	25	Moderate
CF26	Client abuse/clientelism	3.19	0.05	0.223	26	Moderate
CF27	Intimidations and threats	3.15	0.00	0.327	27	Moderate

Table 4: Causes of corruption variables

Code	Variables	Mean	N-V	Rank	Criticality
CC 1	Personal greed	3.92	1.00	1	High
CC 2	Inadequate sanctions	3.77	0.83	2	High
CC 3	Flawed regulation system	3.74	0.80	3	High
CC 4	Lack of coordination among Government departments	3.71	0.77	4	High
CC 5	Inappropriate political interference	3.71	0.77	5	High
CC 6	Over close relationship	3.71	0.77	6	High
CC 7	Lack of legal awareness	3.69	0.74	7	High
CC 8	Lack of rigorous supervision	3.69	0.74	8	High
CC 9	Negative role models	3.66	0.71	9	High
CC 10	Insufficient legal punishment and penalties	3.66	0.71	10	High
CC 11	Lack of a positive industrial climate	3.61	0.66	11	High
CC 12	Poor documentation of records	3.61	0.66	12	High
CC 13	Lack of pro-active steps by funders to limit corruption on projects	3.60	0.64	13	High
CC 14	Poor professional ethical standard	3.60	0.64	14	High
CC 15	Delaying the payment of workers" salaries	3.56	0.60	15	High
CC 16	Asymmetric information amongst project parties	3.55	0.59	16	High
CC 17	Great project complexity	3.55	0.59	17	High
CC 18	Subjecting workers to Job insecurity, especially in government and public enterprises	3.52	0.56	18	High
CC 19	Transition of government	3.52	0.56	19	High
CC 20	Over competition in tendering process	3.50	0.53	20	High
CC 21	Multifarious license or permits	3.50	0.53	21	High
CC 22	Insufficient transparency in the selection criteria for tenders	3.50	0.53	22	High
CC 23	Low wage level	3.50	0.53	23	High
CC 24	Absence of project anti-corruption systems	3.48	0.51	24	High
CC 25	Appointment of a local representative who acts on behalf of the firm to obtain contracts	3.45	0.48	25	High
CC 26	Absence of control mechanism	3.44	0.47	26	Moderate
CC 27	Economic survival	3.40	0.42	27	Moderate
CC 28	Lack of frequency of projects	3.30	0.31	28	Moderate
CC 29	Deficiencies in rule and laws	3.29	0.30	29	Moderate
CC 30	Complexities of institutional roles and functions	3.29	0.30	30	Moderate
CC 31	Deregulation in the public construction	3.27	0.28	31	Moderate
CC 32	Absence of effective and responsible administrative systems	3.26	0.27	32	Moderate
CC 33	Fierce competition	3.24	0.24	33	Moderate
CC 34	Weak procurement/contractual structures	3.23	0.23	34	Moderate
CC 35	Feeble semblance of public interest	3.16	0.16	35	Moderate
CC 36	Complex contractual structure	3.15	0.14	36	Moderate
CC 37	The nature of infrastructure	3.14	0.13	37	Moderate
CC 38	The nature of corruption being a secret activity	3.02	0.00	38	Moderate

VALIDATION QUESTIONNAIRE

Please, kindly respond to separate questions on both contractual and procurement irregularities as presented in the following page sections.

Questionnaire for Part B: Forms and Causes of Corruption in Public Infrastructure Procurement

1. Please, kindly choose the suitable score for each validation aspect/question to indicate the extent of your satisfaction: **1 – Poor; 2 – Average; 3 – Good; 4 – Very good; 5 – Excellent.**

No.	Validation Questions ***(on forms of corruption)***	Evaluation Scale
1	Are the 27 forms of corruption prevalent in the process of infrastructure procurement in Ghana?	☐1; ☐2; ☐3; ☐4; ☐5
2	Can the 27 forms established contribute to the forms of corruption in the procurement sector?	☐1; ☐2; ☐3; ☐4; ☐5
3	Are the 27 forms of corruption established, critical in the Ghanaian infrastructure procurement?	☐1; ☐2; ☐3; ☐4; ☐5
4	Do the impact of their criticalities have adverse effects on the procurement sector and the general economy?	☐1; ☐2; ☐3; ☐4; ☐5
5	Are the rankings of the identified forms reasonable?	☐1; ☐2; ☐3; ☐4; ☐5

No.	Validation Questions ***(on Causes of corruption)***	Evaluation Scale
1	Are the 38 causes of corruption established, critical in the Ghanaian infrastructure procurement towards the incidence of corruption?	☐1; ☐2; ☐3; ☐4; ☐5
2	Do the 38 causes of corruption obscure the normal process of infrastructure procurement in Ghana?	☐1; ☐2; ☐3; ☐4; ☐5
3	Can the 38 causes of corruption established contribute or create room for corruption to occur?	☐1; ☐2; ☐3; ☐4; ☐5
5	Are the rankings of the identified causes reasonable?	☐1; ☐2; ☐3; ☐4; ☐5

2. Among the listed 27 forms and the 38 causes, which 6 of each construct can have extreme negative impacts on the procurement process and as well render the process vulnerable to the incidence of corrupt practice?

Rank	***Forms*** ID (e.g., CF2)	Rank	***Causal Factors*** ID (e.g., CC2)
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	

3. Other comment (general or specific)

Part C: Anticorruption Measures and the Barriers to Effective Application of Anticorruption Measures in Public Infrastructure Procurement

1. Please, kindly choose the suitable score for each validation aspect/question to indicate the extent of your satisfaction: **1 – Poor; 2 – Average; 3 – Good; 4 – Very good; 5 – Excellent.**

Table 5: Anti-corruption measures

Code	Variables	Mean	N-V	Rank	Effectiveness
AC1	Good leadership	3.31	1.00	1	Moderate
AC2	Contract monitoring	3.24	0.84	2	Moderate
AC3	Professional associations	3.24	0.84	3	Moderate
AC4	Whistle-blowing mechanism	3.24	0.84	4	Moderate
AC5	Procedural compliance	3.19	0.73	5	Moderate
AC6	Information technology	3.11	0.55	6	Moderate
AC7	Efficient reporting system (independent hotline)	3.11	0.55	7	Moderate
AC8	Rigorous supervision among others	3.10	0.52	8	Moderate
AC9	Raising awareness	3.08	0.48	9	Moderate
AC10	Rigorous technical auditing system	3.07	0.45	10	Moderate
AC11	Dismissal from employment or other disciplinary action	3.03	0.36	11	Moderate
AC12	Enhance communication	3.03	0.36	12	Moderate
AC13	Education	3.03	0.36	13	Moderate
AC14	Harsh punishment or penalty	3.02	0.34	14	Moderate
AC15	Contractual compliance	3.00	0.30	15	Moderate
AC16	Compliance to fairness and transparent procedures	2.98	0.25	16	Moderate
AC17	Comprehensive rules and regulations	2.98	0.25	17	Moderate
AC18	Training and development initiatives	2.97	0.23	18	Moderate
AC19	Transparency mechanism	2.97	0.23	19	Moderate
AC20	Ethical code	2.97	0.23	20	Moderate
AC21	Debarment/promoting fair debarment procedures	2.94	0.16	21	Moderate
AC22	Increase in accountability	2.94	0.16	22	Moderate
AC23	Effective investigation, court proceedings, departmental disciplinary action	2.92	0.11	23	Moderate
AC24	Access to information	2.90	0.07	24	Moderate
AC25	Financial disclosure/Disclosure	2.90	0.07	25	Moderate
AC26	Development of strong political and ethical will to enforce existing anti-corruption policies and laws.	2.87	0.00	26	Moderate

Table 6: Barriers to effective application of anti-corruption measures

Code	Variables	P-Mean	S-Mean	Sig	Impact	N-V	Rank	Criticality
BAC1	Lack of knowledge and understand of their rights within a contractual environment, difficulty in providing concrete evidence	3.82	3.90	14.90	3.86*	1.00	1	High
BAC2	Political and structural barriers	3.65	3.95	14.42	3.80*	0.88	2	High
BAC3	Fear of insecurity which includes fear of losing Job	3.77	3.82	14.40	3.79*	0.86	3	High
BAC4	Bureaucratic process of reporting corrupt cases	3.69	3.82	14.10	3.75*	0.78	4	High
BAC5	Fear of victimization	3.81	3.56	13.56	3.68*	0.65	5	High
BAC6	Perception of no better end result, distrust in system	3.74	3.63	13.58	3.68*	0.65	5	High
BAC7	Lack of political will, A lack of political will by government officials and statutory professional councils to fight corruption is seen as an exacerbating factor	3.73	3.63	13.54	3.68*	0.65	5	High
BAC8	Personal attitude, for example, lack of will to become involved in fighting corruption	3.73	3.63	13.54	3.68*	0.65	5	High
BAC9	Lack of knowledge or non-familiarity with ethical codes organizational codes of ethics	3.69	3.56	13.14	3.62*	0.53	6	High
BAC10	Inappropriate staffing	3.60	3.63	13.07	3.61*	0.51	10	High
BAC11	Social or occupational stigma and rejection	3.48	3.61	12.56	3.54*	0.37	11	High
BAC12	Lack of independence	3.52	3.56	12.53	3.54*	0.37	11	High
BAC13	Fear of being marginalized	3.61	3.37	12.17	3.49*	0.27	13	High
BAC14	Social misrepresentation	3.39	3.42	11.59	3.40	0.10	14	Moderate
BAC15	Fear of being caught reporting	3.39	3.37	11.42	3.38	0.06	15	Moderate
BAC16	Inappropriate internal institution coordination/inter agency relations	3.21	3.52	11.30	3.36	0.02	16	Moderate
BAC17	Fear of losing life	3.44	3.27	11.25	3.35	0.00	17	Moderate

VALIDATION QUESTIONNAIRE

Please, kindly respond to separate questions on both contractual and procurement irregularities as presented in the following page sections.

Questionnaire for Part C: Anticorruption Measures and the Barriers to Effective Application of Anticorruption Measures in Public Infrastructure Procurement

1. Please, kindly choose the suitable score for each validation aspect/question to indicate the extent of your satisfaction: **1 – Poor; 2 – Average; 3 – Good; 4 – Very good; 5 – Excellent.**

No.	Validation Questions ***(on anti-corruption measures)***	Evaluation Scale
1	Are the 26 anti-corruption measures established, important towards the eradication of corruption in the Ghanaian infrastructure procurement?	☐1; ☐2; ☐3; ☐4; ☐5
2	Are all 26 anti-corruption measures moderately effective in the procurement process as rated by the respondents?	☐1; ☐2; ☐3; ☐4; ☐5
3	Can the 26 anti-corruption measures established contribute or create transparency and accountability in the procurement process?	☐1; ☐2; ☐3; ☐4; ☐5
4	Can the impact of their effectiveness contribute to the good image of the public procurement sector and the general economy?	☐1; ☐2; ☐3; ☐4; ☐5
5	Are the rankings of the identified forms reasonable?	☐1; ☐2; ☐3; ☐4; ☐5

No.	Validation Questions ***(on Barriers to effectiveness of ACM)***	Evaluation Scale
1	Are the 17 barriers established, critical in the Ghanaian infrastructure procurement?	☐1; ☐2; ☐3; ☐4; ☐5
2	Do the 17 barriers impede the effective application of and enforcement of anti-corruption measures in the procurement process in Ghana?	☐1; ☐2; ☐3; ☐4; ☐5
3	Can the 17 barriers established contribute or create room for corruption to occur?	☐1; ☐2; ☐3; ☐4; ☐5
4	Can the impact of their criticalities have adverse effects on the general economy?	☐1; ☐2; ☐3; ☐4; ☐5
5	Are the rankings of the identified causes reasonable?	☐1; ☐2; ☐3; ☐4; ☐5

2. Among the listed 26 anti-corruption measures and the 17 barriers established, which 6 of each construct can have extreme impacts (both positive and negative respectively) on the procurement process and as well contribute to transparency (Anti-corruption measures) or render the process vulnerable to the incidence of corrupt practice in the case of the barriers?

Rank	***Anticorruption Measures*** ID (e.g., AC2)	Rank	***Barriers*** ID (e.g., BAC1)
1		1	
2		2	
3		3	
4		4	
5		5	
6		6	

3. Other comment (general or specific)

Part D: Susceptibility of the procurement activities and stages to corrupt practices

Table 7: Activities and their respective stages of the procurement process

	Procurement Process (TS[a])		ID	Mean	N-Value	Weighting	Vulnerability
1	Pre-Contract stage	Define requirements	PCS1	2.63	0.00	0.133	Moderate
2		Procurement process planning and strategy development	PCS2	3.05	0.27	0.155	Moderate
3		Pre-tender survey	PCS3	3.15	0.33	0.160	Moderate
4		Obtaining necessary approvals	PCS4	3.52	0.56	0.178	High
5		Soliciting tenders	PCS5	4.02	0.88	0.204	High
6		Receipt of tenders	PCS6	3.35	0.46	0.170	Moderate
7	Contract Stage	Pre-tender meeting (Establishing Evaluation Criteria, Evaluation Plan, Evaluation Criteria)	CTS1	3.40	0.49	0.182	Moderate
8		Tender evaluation (review to approve or reject bids)	CTS2	4.00	0.87	0.214	High
9		Select contractor	CTS3	4.21	1.00	0.225	High
10		Award contract/Purchase order	CTS4	3.74	0.70	0.200	High
11		Preparation and Signing of Contract	CTS5	3.35	0.46	0.179	Moderate
12	Contract administration stage ***(CAS)***	Issuing contract amendments	CAS1	3.13	0.32	0.238	Moderate
13		Monitor Progress	CAS2	3.39	0.48	0.257	Moderate
14		Follow up delivery	CAS3	2.97	0.22	0.226	Moderate
15		Administer Progress payments	CAS4	3.68	0.66	0.279	High
16	Post contract phase	File final action Contractor agreement to final claim	PCP1	3.48	0.54	0.165	High
17		Issue final contract amendment	PCP2	3.51	0.56	0.167	High
18		Complete of financial audits	PCP3	3.48	0.54	0.165	High
19		Check for proof of delivery	PCP4	3.76	0.72	0.178	High
20		Return of performance bonds and close-out	PCP5	3.45	0.52	0.164	High
21		Ensure completeness and accuracy of file documentation	PCP6	3.39	0.48	0.161	Moderate

Questionnaire for Part D: Susceptibility of the procurement activities and stages to corrupt practices

1. Please, kindly choose the suitable score for each validation aspect/question to indicate the extent of your satisfaction: **1 – Poor; 2 – Average; 3 – Good; 4 – Very good; 5 – Excellent.**

No.	Validation Questions ***(on Procurement Irregularities)***	Evaluation Scale
1	Are the 21 procurement activities established, vulnerable to corrupt practices?	☐1; ☐2; ☐3; ☐4; ☐5
2	Can all the 21 procurement activities established be plagues with corrupt activities?	☐1; ☐2; ☐3; ☐4; ☐5
3	Can the impact of their vulnerabilities have adverse effects on the procurement sector and the general economy?	☐1; ☐2; ☐3; ☐4; ☐5
4	Are the rankings of the identified activities and stages reasonable?	☐1; ☐2; ☐3; ☐4; ☐5

2. Among the listed 21 procurement activities established which 6 of each construct can have extreme susceptibility to corrupt practices?

Rank	***Procurement Activities*** ID (e.g., PCP2)
1	
2	
3	
4	

5	
6	

3. Other comment (general or specific)

-The End-

Please, we are very grateful for your valuable contribution and time spent on validating our questionnaire. Please, if you would want to receive the final feedback of the validation, kindly provide your email address here: _____

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