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Mapping Corruption in Public Roads Construction

In Lebanon

By

Rami Elias Saba

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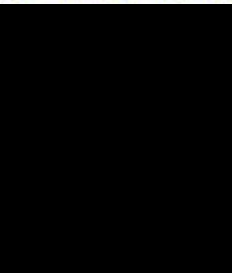|				
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Mapping corruption in Public roads construction

In Lebanon

ABSTRACT

Corruption in public works construction is a problem that governments and political administrations have to contend with all over the world. Lebanon is no stranger to this situation with the country ranking in the most corrupt tier as per Transparency International (TI, 2017). Corruption in public works results in the direct loss of public monies, delays in delivery of projects, and reduced quality of the services delivered. Infrastructure expenditures represent 12 to 15% of GDP in most countries and public roads' construction represents the largest single expense item. The work presented herein endeavored to answer the question about whether corruption is present in public roads construction projects in Lebanon, what are its most common forms and where does it appear in the project delivery process, and finally what possible remedies can be implemented to reduce it.

An extensive literature review was carried out to identify the forms of corruption that could be encountered in public works in general and the roads construction sector in particular as well as possible remedial measures that could be proposed.

A comprehensive questionnaire was developed and administered through structured interviews inquiring about 26 potential problems indicative of corruption and offering 10 possible remedial measures. The responses of 79 seasoned professionals were analyzed as one group and then from the perspectives of three distinct subgroups namely: contractors,

consultants and public servants. Frequency indexes were calculated to rank the various

forms of corruption identified and a commercial statistical analysis package was used to

calculate difference/similarity in perception of corruption and correlation allowing the

analysis of various connections between the answers and the identification of group bias.

Results were also organized and analyzed by project delivery stage. Proposed solutions

were ranked allowing the identification of consensus areas and priority interventions.

This research represents the first one of its kind in Lebanon and the whole region and its

quantitative and qualitative findings represent the first step in improving governance and

developing anti-corruption strategies in the public works sector.

Keywords: Corruption, Road projects, Lebanon, Public Work, Construction Industry,
Consultant, Contractor.

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CHAPTER 1
INTRODUCTION

1.1 CORRUPTION IN PUBLIC WORKS CONSTRUCTION

The most common definition for corruption is the one provided by World Bank: "Corruption is the abuse of public funds and/or office for private or political gain" (WB, 2009). Others have defined corruption in public procurement and public works as an act of fraud, bribery, embezzlement or kickbacks (Sohail and Cavill, 2008).

Corruption in public work projects has been a scourge that governments and political administrations have had to face over modern history. It has recently been the object of formal research in multiple fields such as economics, political sciences and more recently project management. Some researchers have studied corruption in order to minimize financial losses (Collier et al, 2015; Fazekas, 2018); others have studied corruption so that decision makers are advised of unethical practices that may arise during the execution of public projects at any stage (Sohail and Cavill, 2008), others have tried to identify corruption acts that are specific to a given political context or state and make recommendations for the enhancement and welfare of society (Sichombo et al, 2009; Bowen et al, 2012). Giorgio Locatelli et al. (2017) observed that only three papers were found in recent project management publications mentioning the word "corruption" in either their article title, abstract or keywords which shows the reluctance of engineering management professionals to address this issue head on.

Svensson (2005) found out that corruption is a direct cause of political and economic problems in developing countries. Kenny (2007) stated that road construction projects represent between 5 to 7 percent of the GDP in most countries and account for a significant part of global gross capital expenditure; a little less than 33%. Moreover, Estache (2014) reported that infrastructure expenditures add up to 12 to 15% of GDP in most countries representing 50 to 100% more than what is spent on health or education. Thus any corruption related to the public works sector would have a significant effect on the economy of the country in question.

1.2 CORRUPTION IN LEBANON

Corruption is unfortunately extensively present in Lebanon. In a recent poll asking people if corruption has recently increased in their country, CNN got the agreement of 92% of the Lebanese respondents (CNN, 2016). Transparency International ranked Lebanon in the 143th place out of 175 countries worldwide with a corruption index of 28/100 (TI, 2017). Leenders (2004) enumerated examples illustrating corrupt acts by public officials in Lebanon such as bribes, informal costs, gifts, inflating health bills, fraud etc. . Kenny (2007) mentioned that more than 50% of the firms in Lebanon expected to give gifts in order to get a construction permit. Corruption in Lebanon has become entrenched in local culture and political practice to a point where the ideal form of leadership to which political leaders and wannabees aspire is that of "effective corrupt leadership" (Neal and Tansey ,2010).

1.3 OBJECTIVE AND SCOPE

The objective of the proposed research work is to identify and illustrate the major forms of corruption in the Lebanese public roads construction sector by means of carrying extensive interviews, administering a survey to a representative sample of protagonists and analyzing the data. The survey questions aim to uncover practices, patterns and perceptions among different categories of stakeholders and to identify avenues for actions that the government can use to combat corruption.

The objective will be achieved by:

- Collecting information about different forms of corruption via questionnaires and free form interviews.
- Describing the public work procedures corresponding to the most common project delivery methods in Lebanon and identifying corruption risks and possible corruption methods.
- Analyzing the data.
- Proposing recommendations in order to combat/reduce corruption.

An extensive literature review was carried out in order to gather possible forms of corruption that can arise at different stages in public construction projects from the planning stage to the delivery of the project and identify different stakeholders that are prone to any type of corruption. The survey collected responses from 79 contractors, consultants, public officials working in public roads construction in Lebanon. Statistical analysis of the results was then performed on the data. This study

will contribute to future research works on corruption in other public works sectors in

Lebanon and will inform attempts at finding ways to reduce it.

1.4 THESIS OUTLINE

The work presented here is divided into five chapters, as follows:

1. Chapter 1 – Introduction: This chapter presents an introduction to the topic and the research's objectives and scope of work.

2. Chapter 2 – Literature Review: This chapter presents a review of previous research publications relevant to corruption in public works. This chapter is mainly divided into three parts summarizing the published literature that was covered. The first part consists of the research publications related to corruption forms in construction projects in various countries. The second group includes research publications related to transport and roads projects. The third group presents research that attempts to measure corruption or rank corrupt acts.

3. Chapter 3 – Research Methodology: This chapter presents a description of the different steps that were taken in this study in order to reach the objectives.

4. Chapter 4 – Analysis of Findings: This chapter includes a detailed analysis and description of the findings of this research.

5. Chapter 5 – Conclusion and Recommendations: This chapter presents a summary of the different findings along with recommendations for future research.

CHAPTER 2
LITERATURE REVIEW

2.1 DEFINITION OF CORRUPTION

There is a universal consensus that corruption has a direct effect on project costs and delays. Many researchers have tried to identify corrupt activities that are specific to a society's cultural norms and ethics and to propose actions to fight this corruption and promote transparency. However, there is no single or common definition concerning corruption that is accepted universally. First of all, it is useful to look at different definitions of corruption before studying its forms and effects. As mentioned before, the definition mostly used by the researchers for corruption was the one proposed by the World Bank: "Corruption is the abuse of public funds and/or office for private or political gain" (WB, 2009). Sohail and Cavill (2008) defined corruption as an act of fraud, bribery, embezzlement, and kickbacks. A commonly quoted definition used by Transparency International (TI, 2011): "Corruption involves behavior on the part of officials in the public sector, whether politician or civil servants, in which they improperly and unlawfully enrich themselves or those close to them, by the misuse of the public power untrusted to them." Leys (1965) stated that corruption is "behavior that breaks some rule, written or unwritten, about the proper purpose to which a public office/institution has been put."

First adopted in 1914, the American Society of Civil Engineers (ASCE) Code of Ethics is the model for professional conduct for ASCE members. The Code of Ethics in its last version of July 29, 2017 is composed of 8 canons. Canon 6 states that "Engineers shall act in such a manner as to uphold and enhance the honor, integrity, and dignity of the engineering profession and shall act with zero tolerance for bribery,

fraud, and corruption" highlighting the importance of fighting corruption wherever it is found in the practice of civil engineers. The ASCE canon is reflected in most engineering codes of ethics found around the world including the Lebanese Order of Engineers bylaws.

Given the importance of this topic and its effect on national economies, many research efforts have focused on the various aspects of corruption in public works projects. The research publications found in the literature are focused on detecting corruption forms and strategies to reduce corruption in different societies worldwide. The following section will focus on the findings of these research publications to uncover corrupt activities that can be specific to the Lebanese road construction projects.

2.2 SURVEY OF PREVIOUS PUBLICATION ON CORRUPTION IN PUBLIC WORKS.

2.2.1   Forms of corruption

Corruption can take various forms depending on the culture and the norms of every society: Bueb and Ehlermann-Cache (2005) listed various forms of corruption throughout four principal stages of the public procurement process: (1) identification of needs (2) the definition of specifications, (3) awarding the contract and (4) performing the contract. Sohail and Cavill (2008) described examples of corruption in the different stages of infrastructure delivery and the stakeholders that can be involved in corruption at each stage, strategies were presented to fight corruption such as: raising awareness, strengthening professional institutions, enforcement measures and monitoring them, increasing transparency around construction projects and blacklisting companies that are caught offering bribes. Sichombo et al. (2009) outlined the need for and benefits of technical auditing in the Zambian construction industry. They concluded that the pre-contract stage was more susceptible to unethical crimes than the post-contract stage, making the appointment of technical auditors at planning stage more appropriate. The prevalent unethical practices at the pre- contract stage according to respondents for their survey were: contractor fraudulent qualifications, initiation of unnecessarily large projects, manipulation of pre-qualifications, disclosure of lowest quotation, non-declaration of conflict of interest, non-disclosure of financial status and collusion or bid rigging; whereas major unethical practices at post-contract stage were: usage of inferior material quality, increased number of variation claims, extortion by owner's personel, falsework certification and delayed issuance of certificate. Osei-Tutu et al. (2010) discussed

corruption practices inherent to public procurement of infrastructure projects in Ghana such as conflict of interest, bribery, embezzlement, kickbacks, tender manipulation and fraud. They suggested the constitution of a sound procurement system and pro-social equity policies that would foster good governance, corporate social responsibility, transparency, accountability, judicious public expenditure, and national progress in order to control corruption practices. Mahmood (2010) presented the World Bank's assessment of the Bangladesh public construction industry; it concluded that the implementation of the procurement process is far from satisfactory, due to the following problems: poor advertisement, short bidding periods, poor specifications, nondisclosure of selection criteria, contract awards by lottery, one-sided contract documents, negotiations with all bidders and rebidding without adequate grounds. Bowen et al. (2012) used a survey to uncover forms of corruption and assess solutions in South Africa. Piper (2012) enumerated some red flags to detect fraud. Le et al. (2014), argued that the flawed regulation systems and lack of a positive industrial climate are the two major causes of corruption in China. The authors also indicated that the most influential item in the flawed regulation systems is the negative leader roles along with inadequate sanctions, lack of rigorous supervision and multifarious licenses and permits. The study also suggested five main anticorruption strategies for the Chinese public construction sector: improving procedure design and implementation, disclosing information of awarding public construction projects, imposing rigorous supervision and auditing of public projects, enforcing the execution of corruption-related laws and regulations in practice and establishing the professional ethical standard and strengthening related training. Sieber (2014) funnily noted that "The more concrete is used in the project, the higher the level of corruption". The causes of road works corruption according to him were:

a bias toward large capital projects instead of maintenance of existing networks, a tendency to misuse resources generally by not investing sufficiently in routine maintenance, poor quality of construction and repair work, and fraud in construction and repair work. In addition to this, Sieber explained that the size of infrastructure projects, the uniqueness of projects, government involvement, the number of contractual links, the number of phases, the complexity of projects, and lack of frequency of projects are features encountered in roads construction projects prone to corruption. Siber listed some red flags to detect corruption in roads construction. More recently, Fazekas and Toth (2018) discussed many forms of corruption in European bid evaluation systems such as avoiding competition, using unjustified sole-sourcing or direct contract awards, favoring a particular bidder by tailoring specifications, sharing inside information, avoiding the publication of the call for tenders, using less open and transparent procedure types, short advertisement period, manipulation of evaluation criteria in different degrees, subjective, hard-to-quantify criteria, and excessively short time used for deciding on the submitted bids . Table 1 presents the highlights of the main references used for the design of the questionnaire.

Table 1: Some forms of corruption and suggestions extracted from the survey.

Authors-Area of interest	Corruption forms listed	Suggestions to combat corruption
Bueb and Ehlermann-Cache (2005)	•Identification of needs phase. •The definition of specifications phase. •Awarding the contract phase. •Performing the contract phase.	
Sohail and Cavill (2008)	•Large tabular summary of project stages and actors in corruption.	•Raising awareness. •Strengthening professional institutions. •Enforcement measures and monitoring them. •Increasing transparency around construction projects. •Blacklisting companies that are caught offering bribes. •Appointment of technical auditors at planning stage.
Sichombo et al. (2009) – Zambia	•Contractor fraudulent qualifications. •Initiation of unnecessarily large projects. •Manipulation of pre-qualifications. •Disclosure of lowest quotation. •Non-declaration of conflict of interest. •Non-disclosure of financial status. •Collusion or bid rigging. •Usage of inferior material quality. •Increased number of variation claims. •Extortion by owner's personel. •Falsework certification. •Delayed issuance of certificate.	•Appointment of technical auditors at planning stage.
Osei-Tutu et al. (2010)-Ghana	•Conflict of interest. •Bribery. •Embezzlement. •Kickbacks. •Tender manipulation. •Fraud.	•Constitution of a sound procurement system. •Pro-social equity policies that would foster good governance, corporate social responsibility, transparency, accountability, judicious public expenditure, and national progress in order to control corruption practices.
Mahmood (2010) - Bangladesh	•Poor advertisement. •Short bidding periods. •Poor specifications. •Nondisclosure of selection criteria. •Contract awards by lottery. •One-sided contract documents. • Negotiations with all bidders and rebidding without adequate grounds.	
Fazekas and Toth (2018) - Europe	•Avoiding competition. •Using unjustified sole-sourcing or direct contract awards. •Favoring a particular bidder by tailoring specifications. •Sharing inside information. •Avoiding the publication of the call for tenders. •Using less open and transparent procedure types. •Short advertisement period. •Manipulation of evaluation criteria in	

	different degrees, subjective, hard-to-quantify criteria. •Excessively short time used for deciding on the submitted bids .	
Piper (2012)	•Repeated awards to the same entity. •Competitive bidder complaints and protests. •Complaints about quality and quantity. •Multiple contracts awarded below the competitive threshold. •Abnormal bid patterns. •Agent fees. •Questionable bidder. •Awards to non-lowest bidder. •Contract scope changes. •Numerous post-award contract change orders. •Urgent need or sole source. •Questionable minority/disabled ownership.	
Le et al. (2014)-China	•Flawed regulation systems. •Lack of a positive industrial climate. •Negative leader roles. •Inadequate sanctions. •Lack of rigorous supervision and multifarious licenses and permits.	•Improving procedure design and implementation. •Disclosing information of awarding public construction projects. •Imposing rigorous supervision. •Auditing of public projects. •Enforcing the execution of corruption-related laws and regulations in practice. •Establishing the professional ethical standard. •Strengthening related training.
Sieber (2014)-road projects	•A bias toward large capital projects instead of maintenance of existing networks. • A tendency to misuse resources generally by not investing sufficiently in routine maintenance. • Poor quality of construction and repair work. • Fraud in construction and repair work. • Size of infrastructure projects, the uniqueness of projects, government involvement, the number of contractual links, the number of phases, the complexity of projects, and lack of frequency of projects are featured in roads construction projects prone to corruption.	

2.2.2   Corruption in roads projects

The transport sector is the largest sector in the public construction industry. Kenny (2009) estimated government investments in transport infrastructure alone to be 2 to 3.5 % of the GDP claiming that the transport sector accounts for about half of all construction activities. Road projects are mostly classified as large to megaprojects. The World Bank had in 2008 310 active roads/highways projects accounting for 70% of its transport sector lending (WB, 2009). Locatelli et al. (2017) calculated the cost per km of road in megaprojects in Italy, Spain and France and showed large variance which is indicative of the presence of corruption.

The World Bank has published a sourcebook entitled "Deterring corruption and improving governance in road construction and maintenance" identifying all forms of corruption that can be present in different stages in transport sector along with recommendations to fight corruption (WB, 2009). The Deutsche Gesellschaft fur Internationale Zusammenarbeit (GIZ) has also published a technical report titled "fighting corruption in the road transport sector" with intent to provide a comprehensive overview on corruption in road transport sector for developing countries backed up with numerous practical examples to be used for fighting corruption (GIZ, 2012).

2.2.3 Measuring corruption

It is very hard to measure corruption and researchers have relied on questionnaires to elicit the perception of corruption among the population surveyed. Transparency International has its own scale, ranging from 0 (highly corrupt) to 100 (very clean) for every country (TI, 2017). Svensson (2005) used the corruption perception index (CPI) of Transparency International to measure corruption. B. Sichombo et al. (2009), ranked corrupt acts from the most encountered in Zambian industry to the less encountered using a frequency index FI. Locatelli et al. (2017) have tried to correlate the cost per km of road projects with the CPI.

2.3 CORRUPTION IN LEBANON

In Lebanon, corruption is the people's daily bread. Newspapers have been publishing articles on the matter and accusations among political parties have been exchanged continuously all amidst a lack of transparency in the public administration. Such a situation is indeed a breeding ground for highly politicized debates that are a serious waste of time, while the problems remain not tackled, and the citizens get more and more depressed. Adwan (2004) and Leenders (2004) described numerous corrupt practices in Lebanon. The Lebanese Transparency Association LTA (2008) has worked on illustrating corruption and raising awareness through publications and recommendations for a national strategy.

The purpose of this study is to collect credible data based on the experience of those who work in the construction of public roads in Lebanon, thus mapping related corrupt activities. The data collected will be used to map, rank and understand corruption and to develop fighting mechanisms.

The data, analysis, conclusions and recommendations presented in the following chapters are the first organized attempt of its kind about corruption in public works in Lebanon. Figure 1 below describes the most common project delivery method in Lebanon.
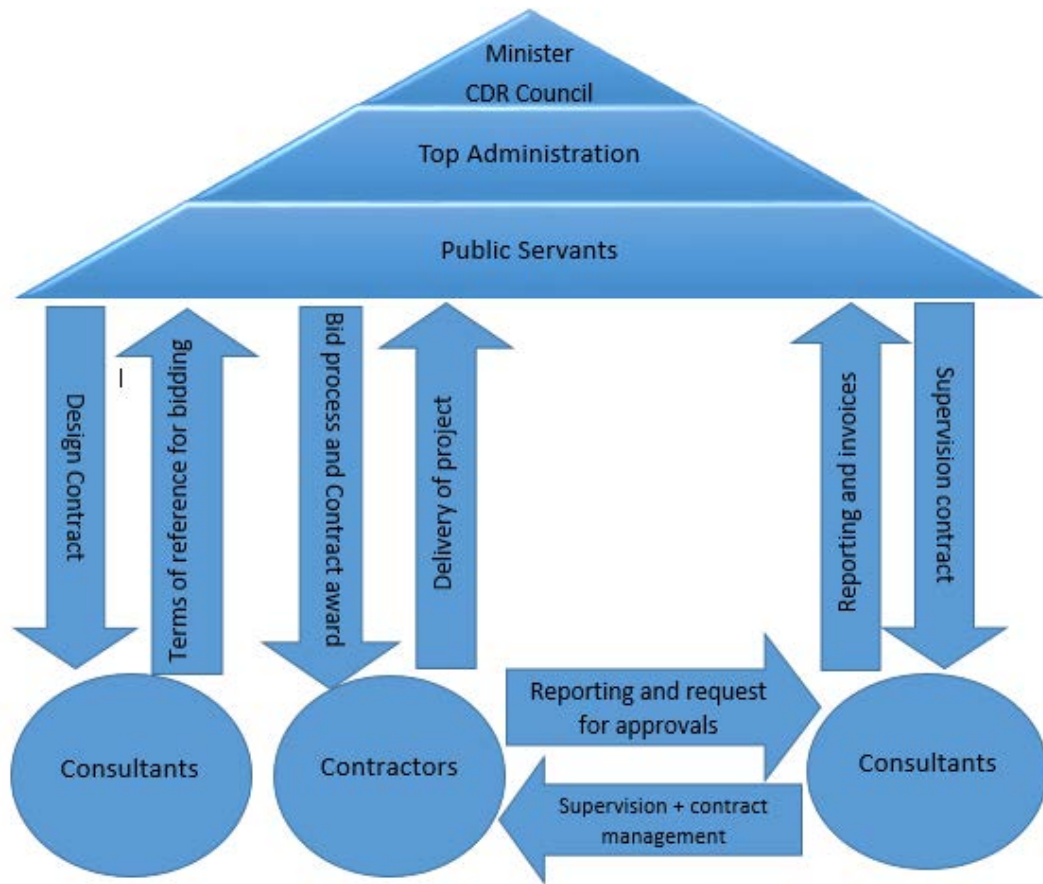
Figure 1: Project Delivery Method in Lebanon.

The two main public institutions responsible for the construction of public roads in Lebanon are the Ministry of Public Works and Transport, MPWT, and the Council for Development and Reconstruction, CDR. The top decision authority is held by the Minister of the MPWT and the Council of the CDR respectively. The decision making authorities of both institutions are supported by two layers of public servants: (1) the top administrators such as directors general, directors and chiefs of services who hold also decision powers and (2) multiple layers of public servants, engineers, technicians, accountants and administrators who are in charge of implementing the decision of the higher authorities and the top administrators.

The typical process for the implementation of a public road construction project starts by the awards of the public institution of a design contract to a consulting firm who in

return prepares a tender file containing terms of reference for the proposed project including: specifications, bills of quantities, design drawings and any other required documents.

Once tender documents are ready the award process is engaged by the public administration and concludes with the award of a construction contract to a qualified company. Following the selection of a contractor, a consultant is selected to supervise the works and to assist the administration in the management of the contract. The project ends when the works are commissioned and approved and all monies are paid and retentions released.

The process by which consultants and contractors are selected can be one of many such as: (i) by negotiation, (ii) by open competitive bidding or by (iii) limited bidding among pre-qualified bidders. The most common award process is by competitive bidding.

CHAPTER 3
METHODOLOGY

3.1 OVERVIEW

In order to collect data about the different forms of corruption that can be encountered in public roads projects, the study started by surveying and analyzing the published literature covering different countries and various types of corruption in public works. The data collected from these research publications represents the foundation for the design of the questionnaire in addition to particular input from meetings with local experts in the field and interviews with public officials. This questionnaire was distributed to professional engineers working with consulting or contracting companies on public roads projects and operating in Lebanon as well as to public servants. The population of experts surveyed was divided into 3 categories: contractors, consultants and public servants. This division ensures that a fair cross-section of stakeholder perceptions is covered and that all kinds of views are reflected. The questionnaire is described in details in the following sections. Multiple statistical tests were performed on the collected data in order to generate meaningful results that can be used for further research. Figure 2 presents a flowchart of the activities that were carried out in this study.
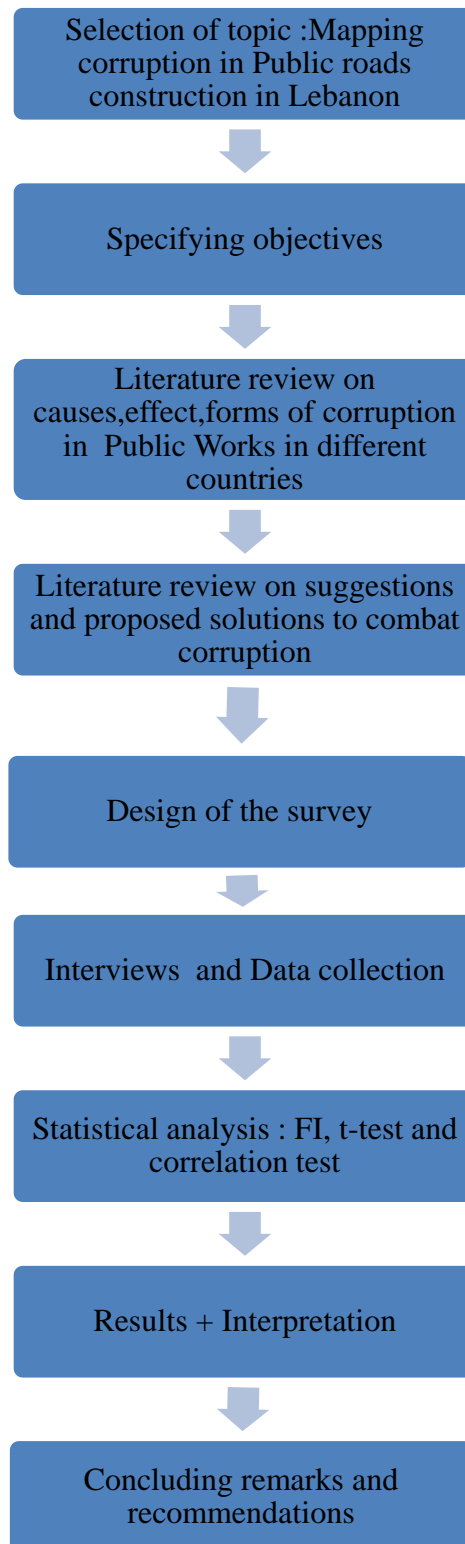
Figure 2: Activities Flowchart.

3.2 SELECTED CORRUPT ACTIVITIES AND POSSIBLE SOLUTIONS.

3.2.1 Corrupt activities

26 types of corrupt activities were selected for testing in the current study from the literature surveyed as they were found most applicable to the local context. These types were organized under three main project stages: planning stage, contract award stage and construction stage. Table 2 below presents selected forms of corruption that have been selected for the survey. Table 3 presents the frequency of corruption forms in the surveyed literature.

ID	Corruption form
P1	Overestimating needs is done so that projects, which are unnecessary or bigger than planned, can be launched.
P2	Splitting a large contract into several smaller ones that are not subject to public procurement regulations.
P3	Reduced publicity, such as publication of contracts in a journal with limited circulation or in domestic journals only.
P4	Adequate time for submission of tender or offer is not provided.
P5	The evaluation of tenders is not done exactly as per the notified criteria.
P6	Contract's terms and references are vague or incomplete.
P7	Contracts' terms and references are made to fit ONE specific contractors.
P8	Some large contracts are set up / obtained by negotiations based on kickbacks and commission fees.
P9	The recurring use of one company in any given field (contractor, supplier, agent….).
P10	Firms benefitting from a "political protection" win the bid.
P11	Bid rigging where the pre-selected contractor wins the tender at a higher price because of contractors' collusion.
P12	Lowest bid price is disclosed to the favored contractor who quotes lower and takes the contract.
P13	Contractors make false claims as to their equipment, employees, company's qualifications in order to win the bid.
P14	Kickbacks were asked for by decision makers and influencers.
P15	Specs modified to accept inferior materials for the benefit of a certain firm.
P16	Modifying services during execution of contract/ multiple payments for same or similar service occurred.
P17	After a contract has been awarded, the decision-maker and the service provider may agree to reduce the services contained in the specifications so that a commission can be paid.
P18	Overbilling or False quantity surveying with proceeds shared between the contractor, the quantity surveyor and the client representative.
P19	Impossible to sanction failure to comply with specifications, either because the necessary clauses have been removed from the contract or because the decision-maker does not enforce them.
P20	Contractor misrepresents the results of quality control (QC) tests to avoid production shutdown or in order to increase profits or limit costs.
P21	The bigger the project the bigger the presence of corruption.
P22	The more the project is unique the bigger the presence of corruption.
P23	Political interference leads to bigger corruption.
P24	The bigger the number of phases the more corruption can be present.
P25	More projects in number and smaller size can lead to less corruption.
P26	Do you think that the government goes towards large capital projects in roads instead of systematic maintenance of existing networks?

Table 3: Frequency of corruption forms in surveyed literature

ID	Bueb & Ehlermann-Cache (2005)	Sohail & Cavill (2008)	Sichombo et al.	GIZ (2012)	Le et al. (2014)
P1	2				
P2	1				1
P3	1	1			2
P4		1		1	1
P5	1		2		1
P6	1			2	
P7	1	1		2	2
P8		1			
P9					1
P10		1			
P11		2	1		
P12					1
P13	1		1		1
P14		4		1	
P15	2	1	1		1
P16	1	1	1	1	1
P17	1				
P18		2			
P19	3				
P20*					
P21*					
P22			1	1	
P23*					
P24*					
P25*					
P26*					

* Identified individually in other publications or by key interviewees.

3.2.2 Possible solutions

Noting that no concrete approach to combat corruption has been proposed by the Lebanese government so far, the survey developed questions focused on providing some possible mitigation actions to the different stakeholders, and asked for their opinion on how they value the proposed recommendations. Actions that all three groups of stakeholders (public servants, contractors and consultants) agree to adopt may be very useful for the enhancement of transparency and accountability in the management of public projects, thus minimizing corrupt practices. 10 possible actions or solutions were proposed in addition to an open ended question where additional suggestions were invited based on the experience of the respondent in the field. Table 4 below summarizes the proposed solutions.

Table 4: Possible mitigating actions/solutions

ID	Solution
S1	A technical auditor will reduce the amount of corruption.
S2	Educating different stakeholders how badly corruption affects their business.
S3	Establishing independent entities to fight corruption in the construction sector.
S4	Improving design in order to minimize: claims by the contractors , mistakes in material quantities , usage of inferior materials …
S5	Improving supervision during the execution of the project.
S6	Reviewing specifications and making them more practical in order to enhance the competition on the project.
S7	Modifying the bid evaluation system/committee.
S8	Empowering corruption fighting institutional mechanisms/upholding rules in the government.
S9	Blacklisting contractors who are practicing any kind of bribery, bid rigging, kickbacks.
S10	Limiting the number of projects any company can benefit from over a specified period of time.

3.3 DESIGN OF QUESTIONNAIRE

The questionnaire constitutes the foundation of the present research and is designed to address the objectives of the study here in. It is based on the development of questions around the corrupt activities that may be present during the execution of the project and recommendations to fight corruption. The questionnaire is composed of three parts. The first part compiles information about the respondents' professional profile, the second part addresses corruption related problems that may be encountered in the Lebanese public roads sector, while the final part tests some suggested solutions for fighting corruption.

3.3.1 Respondent Profile

The first part of the survey targets the respondents' personal profile and includes the following information:

1. Field of Expertise: The first two questions focuses on the position of the respondent in the company; whether he is an owner, a manager for the project, a consultant, contractor or a public servant. These questions are crucial in order to further understand and interpret the perception of the respondent based on his position and the potential biases attached to it.

2. Years of Experience: This question constitutes an important part of the analysis because the amount of experience affects the respondent's perspective on corruption and his exposure to various situations. Project managers or project engineers with more than 10 years of experience were targeted.

3. Level of education: To determine the level of academic training of the respondent.

4. Number of Projects: This question is important because it reflects the level of particular experience of the respondents in road construction projects.

3.3.2 Corrupt activities

The second part constitutes the main and most important part of the survey. Respondents were given the list of all the problems previously identified, where they would have to choose whether they strongly agree, agree, disagree, strongly disagree or stand neutral towards the proposed statement based on their perception and experience in the field. This part can be divided into three groups of problems depending on the project phase concerned as illustrated in Table 5.

3.3.3 Possible solutions

In this part, respondents were asked to express their level of agreement: strongly agree, agree, disagree, strongly disagree or stand neutral, about the proposed solutions as presented in table 4. This will test the effectiveness of each solution and its popularity in order to establish priority and course of intervention.

Table 5: Grouping of corrupt activities.

Planning stage
Overestimating needs is done so that projects can be launched which are unnecessary or bigger than planned.
Splitting a large contract into several smaller ones that are not subject to public procurement regulations.
The bigger the project the bigger the presence of corruption
The more the project is unique the bigger the presence of corruption
Political interference leads to bigger corruption
The bigger the number of phases the more corruption can be present
More projects in number and smaller size can lead to less corruption
Do you think that the government goes towards large capital projects in roads instead of systematic maintenance of existing networks?

Contract award stage
Some large contracts are set up / obtained by negotiations based on kickbacks and commission fees
Reduced publicity, such as publication of contracts in a journal with limited circulation or in domestic journals only.
Adequate time for submission of tender or offer is not given.
The evaluation of tenders is not done exactly as per the notified criteria.
Contract's terms and references are vague or incomplete:
Contracts' terms and references are made to fit ONE specific contractors
The Recurring use of one company in any given field (contractor, supplier, agent….)
Firms benefitting from a "political protection" win the bid:
Bid rigging where the pre-selected contractor wins the tender at a higher price because of contractors' collusion.
Lowest bid price is disclosed to the favored contractor who quotes lower and takes the contract
Contractors make false claims as to their equipment, employees , company's qualifications in order to win the bid:
Kickbacks were asked for by decision makers and influencers

Construction stage
Specs modified to accept inferior materials for the benefit of a certain firm
Modifying services during execution of contract/ multiple payments for same or similar service occurred.
After a contract has been awarded, the decision-maker and the service provider may agree to reduce the services contained in the specifications so that a commission can be paid.
Overbilling or False quantity surveying with proceeds shared between the contractor, the quantity surveyor and the client representative
Impossible to sanction failure to comply with specifications, either because the necessary clauses have been removed from the contract or because the decision-maker does not enforce them.
Contractor misrepresents the results of quality control (QC) tests to avoid production shutdown or in order to increase profits or limit costs.

3.3.4 Sample Size Determination

After defining the content of the questionnaire in the study, it is crucial to define the number of experts that need to be interviewed in order to have a credible sample size to rely on for the analysis of the content. Israel (2013) stated that many factors influenced the determination of the sample size, including the allowable sampling error, the objective of the study, the confidence level and degree of variability. The Cochran's (1977) equation incorporates all the parameters previously listed.

$$n_0 = \frac{Z^2 p(1-p)}{e^2}$$

Where:

"n_0" is the required sample size in this design.

"Z" represents the Z-value relative to the confidence level.

"p" represents the degree of variability. In this study, p=0.5.

"e" represents the sampling error which is taken in this study as e=0.1.

The level of precision, also called the sampling error, is the range in which the true value of the responses is estimated to be. This range is expressed in percentage points. For example, if 55% of the voters were found to support any candidates with a 5% sampling error, then it can be concluded that a range 50% to 60% of the voters are voting for a specific candidate. In this study, and due to the inherent uncertainties in construction projects, a level of precision of 10% is considered acceptable. Thus is set to 0.1.

The confidence level Z denotes the extent of certainty that the sample mean will fall exactly inside the confidence interval. In this study, a 95% level of confidence was considered which is a reasonable level used in similar sampling exercises and empirical researches.

The degree of variability refers to the distribution of attributes in the population. The more heterogeneous a population, the larger the sample size required is in order to obtain the required level of precision. A 50% degree indicates a maximum variability inside a population. It is assumed in this research that the respondents share different insights and perspectives and the highest level of variability will be assumed. 50% variability is considered in this research, hence p=0.5.

Given above selected values, Table 6 illustrates sample size for different precision levels according to the estimated size of the population (Israel,1992).

Table 6: Sample size for different precision level having Z= 95% and P=0.5

Population size	e= 5%	e=7%	e=10%
100	81	67	51
125	96	78	56
150	110	86	61
175	122	94	64
200	134	101	67
225	144	107	70
250	154	112	72
275	163	117	74
300	172	121	76
325	180	125	77
350	187	129	78
375	194	132	80

It is estimated that 20 to 30 contracting companies are active in this sector in Lebanon, with about 10 to 15 consulting companies and two main governmental agencies: the Ministry of Public Works and Transport and the Council for

Development and Reconstruction who share the responsibility for public roads construction and maintenance. Hence it is estimated that Lebanon has a population of 300 to 400 experts in road construction projects therefore a sample size of 76 respondents is enough to properly model the population.

3.4 DATA COLLECTION

The results were gathered and analyzed using Microsoft Excel and the IBM Statistical Package for social sciences SPSS software. In total, 129 questionnaires were sent out and 79 completed responses were received resulting in a response rate of 61%. Of the respondents, 41% were senior managers whereas the others were middle managers or owners. 42% are engineers holding masters degrees and 54% hold bachelor's degrees. In order to compare the significance of the difference in perspectives towards a form of corrupt activity, the responses of two main groups with 30 respondents or more each were contrasted: Group 1 consultants and Group 2 contractors. A third group was identified constituted of public servants

Table 7 below shows the number of respondents of each group of protagonists.

Table 7: Respondents' Profile

Field of Expertise	Number	Percentage
Contractors	36	45.5%
Consultants	30	38%
Public employees	13	16.5%
Total	79	100%

Additional respondent profile information was extracted from the survey including the years of experience and the number of projects. Figure 3 presents the classification of respondents based on the years of experience within each of the three respondent groups. This figure shows a well-experienced sample size with more than 70% of each population having more than 10 years of experience for a total years of experience of over 500. Figure 4 presents the distribution of the respondents based on the number of the road construction projects they were involved in during their careers to date. The anonymity of the respondents was insured in order to get

maximum truthfulness in the information they provided. The sample was chosen to cover companies and project managers operating in all the Lebanese regions from the South to the North. Table 8 illustrates the distribution of the sample among the Lebanese administrative provinces.
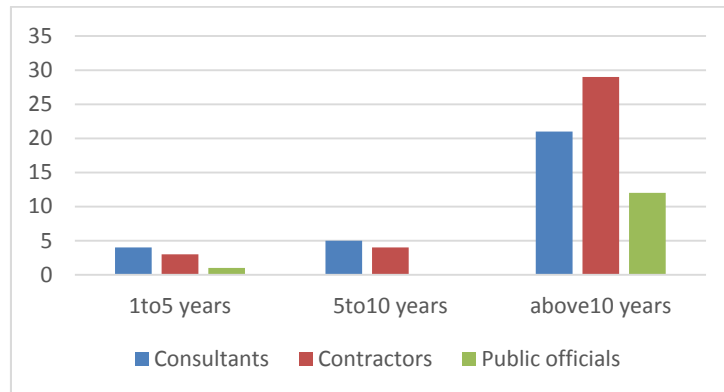
Figure 3: Respondent Profile by Years of Experience

Table 8: Respondent Profile by Area of Operation

Area of Operation	Number of samples
Beirut	36
Mount Lebanon	26
North + Akkar	7
South + Nabatieh	7
Bekaa	3
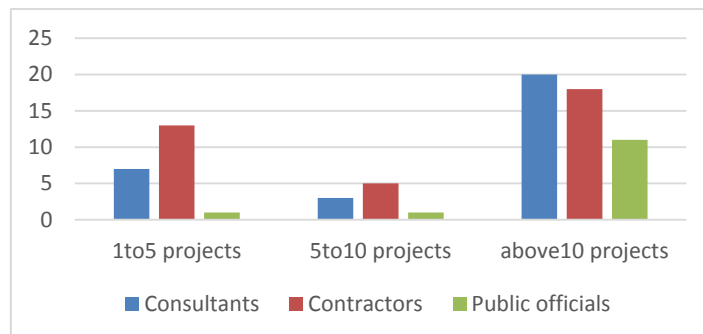
Figure 4: Respondent Profile by number of projects.

3.5 DATA ANALYSIS

The frequency index (FI) used by Sichombo et al. (2009) was calculated for different corrupt acts in order to rank them and highlight their prevalence. The FI was also used in order to rank suggested solutions by their acceptability for the respondents. The frequency index is calculated using the following formula:

$$\text{FI} = \frac{\sum_1^5 R_i \ x \ N_i}{5 \sum_1^5 N_i} \ x \ 100$$

Where:

FI is the frequency index.

R_i is the response type on the Likert scale on which I ranges from 1 to 5.

N_i is the total number of respondents choosing type i; N_5= the number of respondents that answered strongly agree, N_4= the number of respondents that answered agree, N_3= the number of respondents that answered neutral, N_2= the number of respondents that answered disagree, N_1= the number of respondents that answered strongly disagree. Hence, an index ranging from 0.2-0.4 indicates strong disagreement, an index ranging from 0.4-0.6 indicates disagreement, an index ranging from 0.6-0.8 indicates agreement and finally an index ranging from 0.8-1 indicates strong agreement with the corresponding statement.

The independent t-test was used with a confidence level of 95% because it is a test that allows determining statistically significant differences between two groups of an independent variable on a continuous or ordinal dependent variable. This test is used to compare the perception of the two main categories of respondents (contractors and

consultants) considered as the independent variable regarding different major corrupt acts that this study has identified (dependent variable).

The correlation test was used in order to test to which extent different forms of corrupt activities were related to each other in a specific stage and how respondents related them through their answers. Cohen's (1988) scale was used to assess the strength of the relationship: the relationship being small if r (correlation coefficient) lies between 0.1-0.29, medium if r lies between 0.3-0.49 and strong if r lies between 0.5-1.

CHAPTER 4
ANALYSIS OF FINDINGS

4.1 OVERVIEW

A questionnaire was administered to detect opinions and perceptions among consultants, contractors and public servants concerning different corrupt activities in the field of public roads construction. 79 dully filled questionnaires were collected and analyzed using SPSS software. The results were discussed with a small group of experts to validate observations. The responses were analyzed using the frequency index FI factor to highlight the major corrupt activities encountered in Lebanon and to test the efficiency of suggested solutions. The independent t-test was used to test the perception of consultants against those of contractors concerning the various types of corruption. A correlation test was used to correlate different corruption acts and study the relationship between groups of activities.

This chapter is divided into 4 main parts as shown in Figure 5:

- The first section highlights and ranks the principal forms of corruption identified from the survey: according to all respondents, then according to each population alone.

- The second section presents the difference in perception between contractors and consultants concerning the different forms of corruption addressed in the survey.

- The third part of this chapter presents the results of a correlation test done on the responses to the answers to detect the presence of corruption in a particular stage in the project delivery process.

- Finally, the fourth and last section is dedicated to test the perceived efficiency and popularity of the suggested actions that could be taken to enhance accountability and transparency in the field and reduce corruption.

Frequency Index Test
- **Principal forms of corruption in Lebanon**
  - Ranking all surveyed population.
  - Ranking consultants alone.
  - Ranking contractors alone.
  - Ranking public servants alone.

Independant T-Test
- **Perception of corruption**
  - Similarities and differences in perceiving corruption.

Correlation test
- **Detecting corruption in a particular stage of construction**
  - Studying strongly related group of activities.

Frequency Index Test
- **Recommended actions/solutions**
  - Perceived effectiveness of the recommended actions/solutions.

Figure 5: Flowchart of the analysis carried out.

4.2 MAJOR FORMS OF CORRUPTION IDENTIFIED.

One of the objective of this work is to rank by importance the identified corrupt actions as perceived by the various groups of engineering in the public roads construction sector namely the contractors, consultants, and public servants. Depending on the level of agreement of the respondents with the formulation of the problems encountered that are indicative of corruption a frequency index (FI) was calculated to highlight the perceived prevalence of one corrupt act over the others. The FI was calculated for the whole population then for each group queried allowing to detect any differences in perception or priorities among the groups due to the different roles and perspectives they have. Table 9 presents the ranking of all problems stated in the questionnaire according to all respondents.

Table 9: Ranking of all problems stated in the questionnaire according to the total population.

ID	Ranking according to the total population	Frequency index (FI)
P23	1	0.770
P10	2	0.719
P8	3	0.706
P9	4	0.699
P14	5	0.681
P21	6	0.678
P11	7	0.673
P2	8	0.663
P12	9	0.663
P24	10	0.656
P13	11	0.651
P22	12	0.651
P26	13	0.651
P3	14	0.635
P7	15	0.635
P25	16	0.635
P1	17	0.630
P5	18	0.630
P19	19	0.629
P4	20	0.625
P6	21	0.618
P20	22	0.618
P15	23	0.610
P17	24	0.596
P16	25	0.592
P18	26	0.591

4.2.1 Top 5 forms of corruption acts for the total population

Table 10: Top 5 corrupt acts seen by the total populations

Problem	Ranking	FI
Political interference leads to bigger corruption	1	0.77
Firms benefitting from a "political protection" win the bid	2	0.719
Some large contracts are set up / obtained by negotiations based on kickbacks and commission fees	3	0.706
The Recurring use of one company in any given field (contractor, supplier, agent….)	4	0.699
Kickbacks were asked for by decision makers and influencers	5	0.681

Table 10 lists the top 5 forms of corruption for the whole population with "political interference leads to bigger corruption" ranked first with the highest frequency index of 0.77. This shows that all protagonists groups, even public servants, agree on the fact that political interference is the top source of corruption in roads construction projects and many have had negative experiences with this issue. "Firms benefitting from political protection win the bid" came as the second most corrupt form practiced in the sector which echoes the first ranked result. Kickbacks and commission fees are results of this interference and are evident in the sector thus "some large contracts are set up/ obtained by negotiations based on kickbacks and commission fees" ranked third and "Kickbacks and commission fees were asked by decision makers and influencers" came in the fifth place.

Within this context, the usage of one company becomes a natural consequence of all these problems when any company is able to ally itself with a given political party and fulfill its needs through commissions and kickbacks thus building a "confidence zone" that allows easy manipulation of the bidding process and wining over other companies.

The third, fourth and fifth forms covering (i) some large contracts are set up / obtained by negotiations based on kickbacks and commission fees, (ii) the recurring use of one company in any given field (contractor, supplier, agent….), and (iii) kickbacks were asked for by decision makers and influencers, fall all within the abuse of public office for private gain categorization that corresponds to the formation of incestuous business relationships between large contractors seeking protection and political decision makers looking to benefit from their position in order to use political power to secure business in the most brutal expression of the clientelistic system of Lebanon, resulting in a "comfort zone of operation" for all parties to corruption.

4.2.2 Top 5 forms of corruption acts ranked by consultants

Table 11: Top 5 corrupted acts seen by all consultants

Problem	Ranking	FI
Political interference leads to bigger corruption	1	0.787
Firms benefitting from a "political protection" win the bid	2	0.773
Some large contracts are set up / obtained by negotiations based on kickbacks and commission fees	3	0.760
The Recurring use of one company in any given field (contractor, supplier, agent….)	4	0.733
Splitting a large contract into several smaller ones that are not subject to public procurement regulations.	5	0.727

Table 11 presents the ranking of the consultants' population for the top 5 forms of corruption acts with their relative FI. The first 4 problems leading to corruption are totally aligned in ranking with the global ranking but with different frequency indexes. It is important to note that consultants in Lebanon are more "extreme" or

"forthcoming" in expressing their agreement with presented problems which is typical of their professional roles. The fifth ranked among consultants is "splitting large contract into several smaller ones that are not subject to public procurement regulations" instead of kickbacks. This is due to the fact that consultants are less exposed to being asked for kickbacks given the comparative size of their fees. Whereas splitting contracts seems to them a non-optional situation adopted by politicians to escape from the bidding regulations and to try to satisfy a bigger number of their supporters by granting more companies a large number of smaller jobs.

4.2.3 Top 5 forms of corruption acts ranked by contractors

Table 12: Top 5 corrupted acts seen by all contractors.

Problem	Ranking	FI
Political interference leads to bigger corruption	1	0.739
Firms benefitting from a "political protection" win the bid	2	0.7
Some large contracts are set up / obtained by negotiations based on kickbacks and commission fees	3	0.672
Lowest bid price is disclosed to the favored contractor who quotes lower and takes the contract	4	0.672
Kickbacks were asked for by decision makers and influencers	5	0.661

Table 12 presents the ranking of the contractors' population for the top 5 forms of corruption acts with their relative FI. The first 3 problems leading to corruption are totally aligned in ranking with all the respondents' opinions in addition to the fifth problem with different frequency indexes but what is notable is that contractors in Lebanon are more cautious in expressing their agreement with presented problems. In

fact, contractors are more practical and business oriented then consultants who are more technical in dealing with any issue thus their perception of corruption is somehow milder than consultants. What ranked fourth among contractors is an issue particular to their field "Lowest bid price is disclosed to the favored contractors who quote lower and take the contract". This is a major problem that harms the bidding process by eliminating fair competition between contractors and transparency during the evaluation of bids especially that the common practice in Lebanon is that lowest bidder complying with the specifications is awarded the contract.

4.2.4   Top 5 forms of corruption acts ranked by public officials

Table 13: Top 5 corrupted acts seen by all public servants.

Problem	Ranking	FI
Political interference leads to bigger corruption.	1	0.815
The Recurring use of one company in any given field (contractor, supplier, agent….)	2	0.769
The bigger the project the bigger the presence of corruption.	3	0.738
The bigger the number of phase the more corruption can be present.	4	0.723
Bid rigging where the pre-selected contractor wins the tender at a higher price because of contractors' collusion.	5	0.692

Table 13 presents the ranking of the public officials' population for the top 5 forms of corruption acts with their relative FI. Political interference leading to bigger corruption came first aligned with contractors and consultants opinions. However public servants have different perception and priorities. The recurring use of one company is highly ranked within the public sector and they share this issue with the

consultants but with higher importance by ranking it in the second place. Public servants have highlighted that bigger projects need bigger amount of money to be spent and thus the commissions attached are more important than smaller projects. Also, public employees are against multiple phases for any projects (similar to the consultants' concern about splitting contracts) where corruption can occur. "Bid-rigging where the pre-selected contractor wins the tender at a higher price because of contractors' collusion" is a major problem seen by public servants and ranked fifth.

4.2.5 Analysis of the findings

Table 14: Top 5 corrupted acts seen by all populations, consultants' group, contractors' group and public servants' group.

Problem	Ranking	FI	Consultants ranking	FI	Contractors ranking	FI	PS ranking	FI
Political interference leads to bigger corruption	1	0.77	1	0.787	1	0.739	1	0.815
Firms benefitting from a "political protection" win the bid	2	0.719	2	0.773	2	0.7	10	0.646
Some large contracts are set up / obtained by negotiations based on kickbacks and commission fees	3	0.706	3	0.76	3	0.672	6	0.677
The Recurring use of one company in any given field (contractor, supplier, agent….)	4	0.699	4	0.733	8	0.644	2	0.769
Kickbacks were asked for by decision makers and influencers	5	0.681	6	0.72	5	0.661	11	0.646

Table 14 compares relative ranking by groups of the top 5 ranked forms of corruption acts. The following is noted :

- All protagonists groups agreed that political interference is the leading problem that increases corruption.

- When it comes to political protection for firms, it is the second major problem identified by contractors and consultants but only ranked tenth by

public servants. A serious question can be raised here as to public servants perception: How come public servants admit in the first place that political interference leads to higher corruption if in reality, they are not experiencing it while the consultants and contractors who are the first concerned are admitting it as a top concern? And isn't the recurring use of one company in any given field a direct result of political protection? However, in a system where the public servants are directly appointed by politicians it is expected that they may avoid giving an opinion on this particular issue and not to self-incriminate themselves.

- Kickbacks and commission fees are one of the big problems contractors and consultants suffer from and was ranked 5 and 6 respectively whereas public servants didn't lend this problem much importance because this issue may be touchy as it concerns their immediate superiors.

- Public servants and consultants top ranked the recurring use of one company in any given field with little importance granted by the contractors to this issue. It appeared from the interviews that contractors do not have a problem with recurrent use of one company from a business point of view as many of them endeavor to control particular niches in the market or approach many sectors as a cartel. Consultants and public servants share the opposite opinion and consider the recurrent use of one company as a limitation of fair trade and equal opportunity.

4.3 ANALYSIS OF DIFFERENCE IN PERCEPTION TOWARDS CORRUPTION ACTS BETWEEN CONTRACTORS AND CONSULTANTS

The responses gathered from the survey were organized and grouped using Microsoft Excel. This data was then analyzed using SPSS in order to perform the independent t-test on the responses of two different groups (contractors and consultants). This test allows identifying questions whose answers are in disagreement between the two groups. The responses were also presented in histogram form.

Table 15: Results of independent t-test between contractors' group and consultants' group.

Problem	Planning stage	p-value	Result
P1	Overestimating needs is done so that projects can be launched which are unnecessary or bigger than planned.	0.389	Agreement
P2	Splitting a large contract into several smaller ones that are not subject to public procurement regulations.	0.056	Weak agreement
P21	The bigger the project the bigger the presence of corruption	0.11	Agreement
P22	The more the project is unique the bigger the presence of corruption	0.86	Agreement
P23	Political interference leads to bigger corruption	0.325	Agreement
P24	The bigger the number of phase more corruption can be present	0.51	Weak agreement
P25	More project number can lead to less corruption	0.166	Agreement
P26	Do you think that the government goes towards large capital projects in roads instead of systematic maintenance of existing networks?	0.028	Disagreement
	Contract award stage		
P3	Reduced publicity, such as publication of contracts in a journal with limited circulation or in domestic journals only.	0.105	Agreement
P4	Adequate time for submission of tender or offer is not given.	0.707	Agreement
P5	The evaluation of tenders is not done exactly as per the notified criteria.	0.033	Disagreement
P6	Contract's terms and references are vague or incomplete:	0.632	Agreement
P7	Contracts' terms and references are made to fit ONE specific contractors	0.299	Agreement

P8	Some large contracts are set up / obtained by negotiations based on kickbacks and commission fees:	0.147	Agreement
P9	The Recurring use of one company in any given field (contractor, supplier, agent….)	0.093	Weak agreement
P10	Firms benefitting from a "political protection" win the bid:	0.213	Agreement
P11	Bid rigging where the pre-selected contractor wins the tender at a higher price because of contractors' collusion.	0.137	Agreement
P12	Lowest bid price is disclosed to the favored contractor who quotes lower and takes the contract	0.725	Agreement
P13	Contractors make false claims as to their equipment, employees , company's qualifications in order to win the bid:	0.038	Disagreement
P14	Kickbacks were asked for by decision makers and influencers	0.169	Agreement
	Construction stage		
P15	Specs modified to accept inferior materials for the benefit of a certain firm	0.207	Agreement
P16	Modifying services during execution of contract/ multiple payments for same or similar service occurred.	0.002	Disagreement
P17	After a contract has been awarded, the decision-maker and the service provider may agree to reduce the services contained in the specifications so that a commission can be paid.	0.015	Disagreement
P18	Overbilling or False quantity surveying with proceeds shared between the contractor, the quantity surveyor and the client representative	0.002	Disagreement
P19	Impossible to sanction failure to comply with specifications, either because the necessary clauses have been removed from the contract or because the decision-maker does not enforce them.	0.041	Disagreement
P20	Contractor misrepresents the results of quality control (QC) tests to avoid production shutdown or in order to increase profits or limit costs:	0.032	Disagreement

4.3.1 Results of independent t-test

The independent t-test is an inferential statistical test that shows whereas there is a significant difference between the means in two unrelated groups (Laerd Statistics, 2019). The null hypothesis H0 considers that the two population means are equal. The alternative hypothesis H1 considers the opposite. In order to perform the calculations, we need before to set a significance level that allows accepting either hypothesis. In this study, this value is set as 0.05 which is commonly used by researchers

(confidence level of 95%). The dependent variables (test variables) are the problems related to corruption acts stated in the questionnaire whereas the independent variables (grouping variables) are taken as the consultants' group and the contractors' group. Thus, any corruption form with a p-value less than 5% is considered to have a difference in perception between consultants and contractors (rejecting H0 and accepting H1).

As shown in Table 15, the consultants' and contractors' groups have a difference in perception for corruption forms in 8 out of 26 problems. They show a clear agreement in perceiving corruption in the majority of problems encountered in the planning stage: 1 disagreement out of 8 suggested problems. Agreement covered the following problems:

- "P1-Overestimating needs is done so that projects can be launched which are unnecessary or bigger than planned".

- "P2-Splitting a large contract into several smaller ones that are not subject to public procurement regulations".

- "P21-The bigger the project the bigger the presence of corruption".

- "P22-The more the project is unique the bigger the presence of corruption".

- "P23-Political interference leads to bigger corruption".

- "P24-The bigger the number of phases more corruption can be present".

- "P25-More project number can lead to less corruption".

This proves that the perception of corruption encountered in this stage is undisputed between these two groups. The same analysis applies to the contract award stage

where there are only 2 disagreements out of 12 suggested problems; both consultants and contractors gave the same importance to the following problems:

- "P3-Reduced publicity, such as publication of contracts in a journal with limited circulation or in domestic journals only".

- "P4-Adequate time for submission of tender or offer is not given".

- "P6-Contract's terms and references are vague or incomplete".

- "P7-Contracts' terms and references are made to fit ONE specific contractor".

- "P8-Some large contracts are set up / obtained by negotiations based on kickbacks and commission fees".

- "P9-The Recurring use of one company in any given field (contractor, supplier, agent….)".

- "P10-Firms benefitting from a "political protection" win the bid".

- "P11-Bid rigging where the pre-selected contractor wins the tender at a higher price because of contractors' collusion".

- "P12-Lowest bid price is disclosed to the favored contractor who quotes lower and takes the contract".

- "P14-Kickbacks were asked for by decision-makers and influencers".

However, there was a disagreement in perceiving corruption during the construction stage in 5 problems out of 6. The only agreement between the two groups was on P15 "Specs modified to accept inferior materials for the benefit of a certain firm". The remaining 5 problems relate to corrupt acts typically initiated or carried out by contractors hence the disagreement between consultants who see them as problems leading to corruption and contractors who disagree in order to avoid self-incrimination. The disagreement supports the fact that the listed problems constitute a

source of corruption. Further detailed analyses over the perception of parties towards each form of corruption will be discussed in the following sub-sections.

4.3.2 Distribution of Results

All the respondents had to assign a level of agreement to a specific situation. Then a distribution of the results was developed for each group of the protagonists (consultants and contractors). If these distributions differ, then both groups would have a difference in perceiving corruption in any suggested problem or solution. This would be characterized by a low p-value (less than 5%) when performing the independent t-test. The purpose of this section is to analyze the perception of each group alone and comparatively towards corrupt acts at every stage defined in this study by showing the histograms of the response distribution for each group and analyzing the results in light of information gathered in informal interviews of experts

4.3.2.1 Planning stage

At the planning stage, there was no difference in perceiving corruption by both contractor and consultant groups except for problem 26. By examining the response distribution of both groups illustrated in Figure 6 till Figure 13 we can conclude the following:
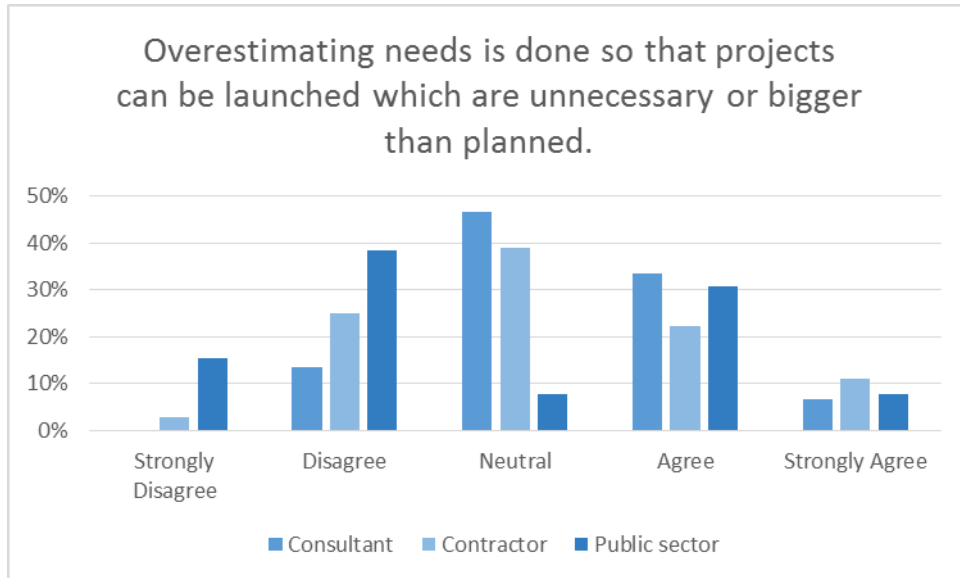
Figure 6: Response Distribution for P1

- With reference to figure 6, the largest proportion of consultants and contractors stand neutral in perceiving corruption when it comes to overestimating needs while assessing projects in Lebanon.
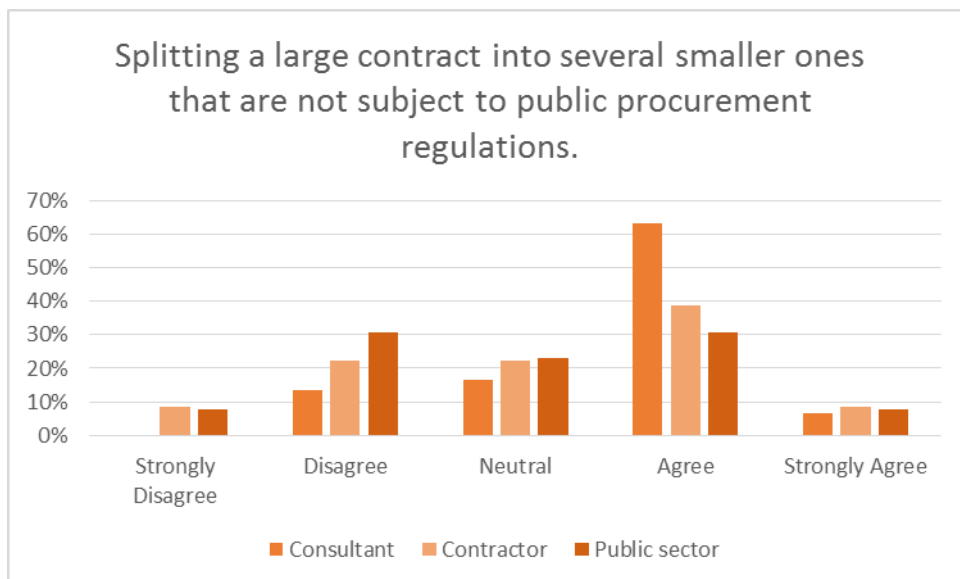
Figure 7: Response Distribution for P2

- With reference to figure 7, 70% of the consultants and around half of the contractors agreed on the fact that there is a policy of splitting large contracts to several smaller ones where corruption can occur to avoid regulations.
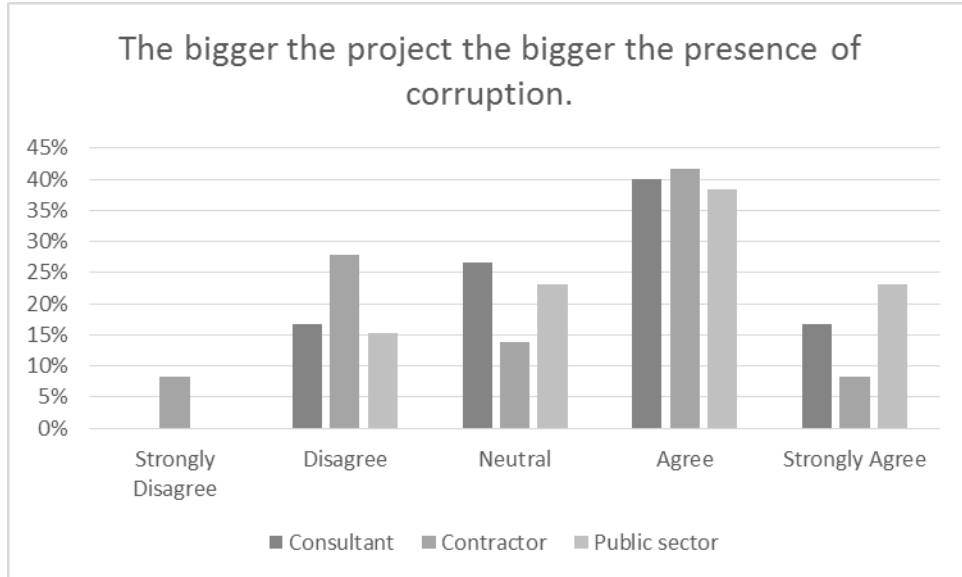
Figure 8: Response Distribution for P21
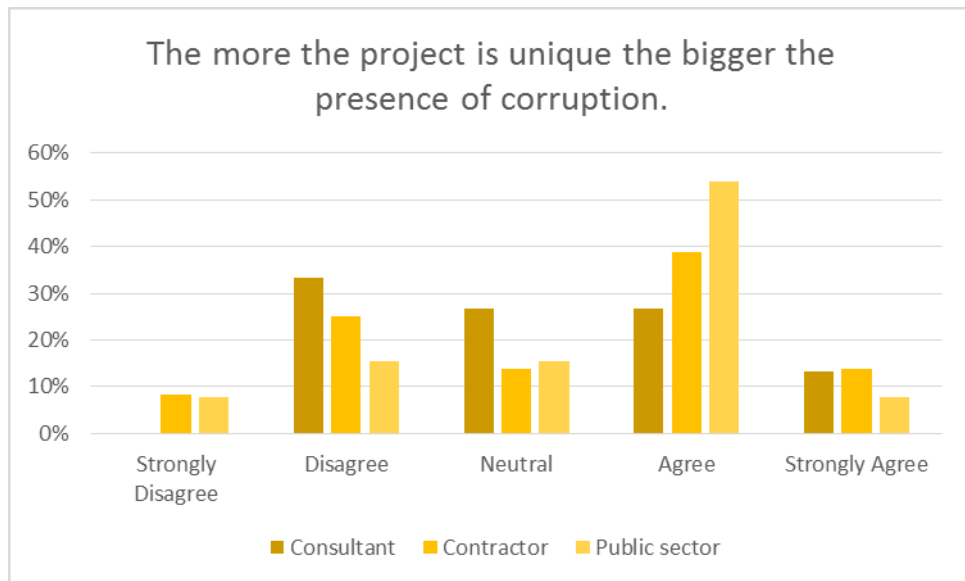
Figure 9: Response Distribution for P22
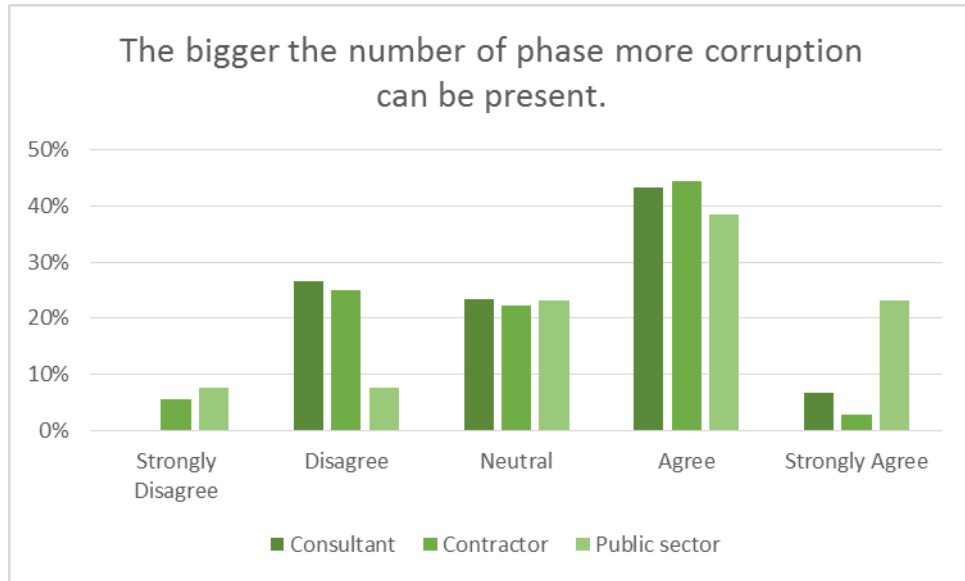
Figure 10: Response Distribution for P24
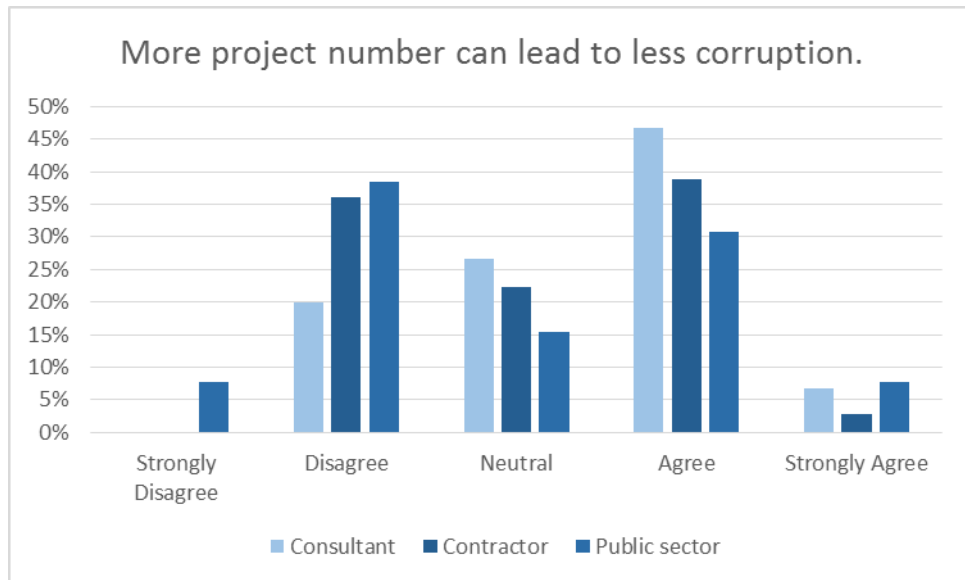
Figure 11: Response Distribution for P25

- With reference to figures 8, 9, 10 and 11; the majority of contractors and consultants in Lebanon agreed on the fact that the more the project is big, unique, divided into phases, the higher the presence of corruption; this agrees with Sieber (2014) who stated that all these factors are conducive to corruption. Sieber also stated that:

"Major projects come at irregular intervals. Winning these projects may be critical to the survival or profitability of contractors, which provides an incentive to contractors to bribe."

This was evident in the responses where the majority of contractors and consultants agreed that the more projects they won the less corruption there is.
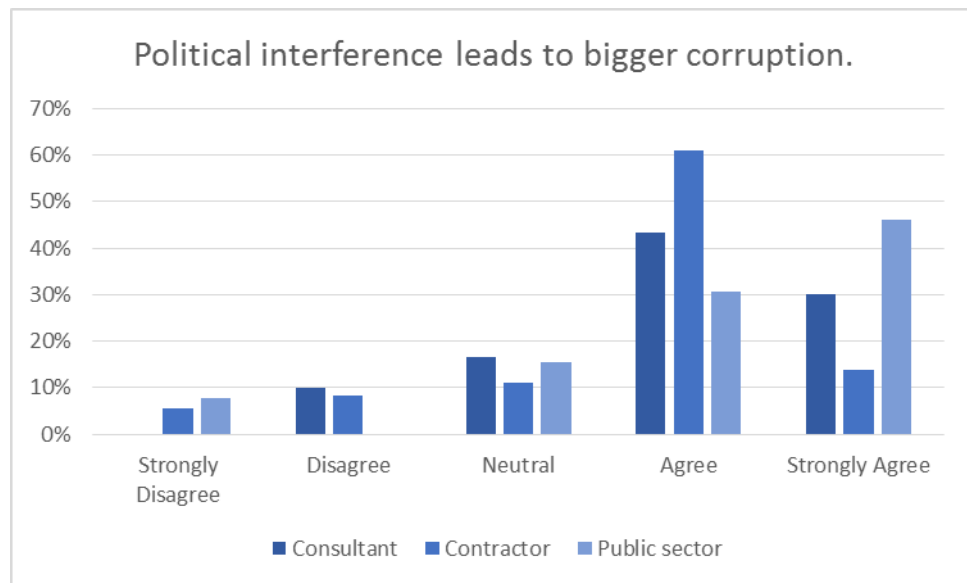
Figure 12: Response Distribution for P23

- With reference to figure 12, political interference was ranked top form of corruption by all groups, got an agreement of more than 70% of both consultants and contractors groups. Political interference leads to bigger costs, lower quality and increases the likelihood that roads go missing according to Lehne et al. (2016).
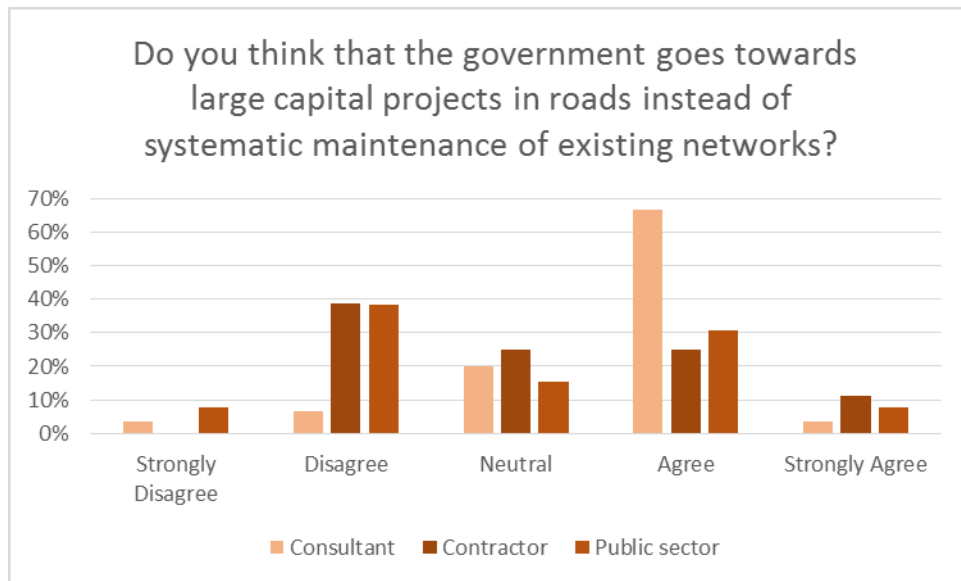
Figure 13: Response Distribution for P26

- With reference to figure 13, different perceptions concerning the policy of the government in initiating large capital projects instead of maintaining existing networks were present: 70% of the consultants agreed on this fact whereas only 36% of contractors agreed. This reflects the professional attitude of consultants concerning the optimality of maintenance over the life cycle of the project whereas the contractors expressed a clear business bias towards larger projects with larger profits.

4.3.2.2 Contract award stage

At the contract award stage, there was no difference in perceiving corruption by both contractor group and consultant group except for two problems. By examining the response distribution of both parties illustrated in Figure 14 to Figure 25 we can conclude the following:
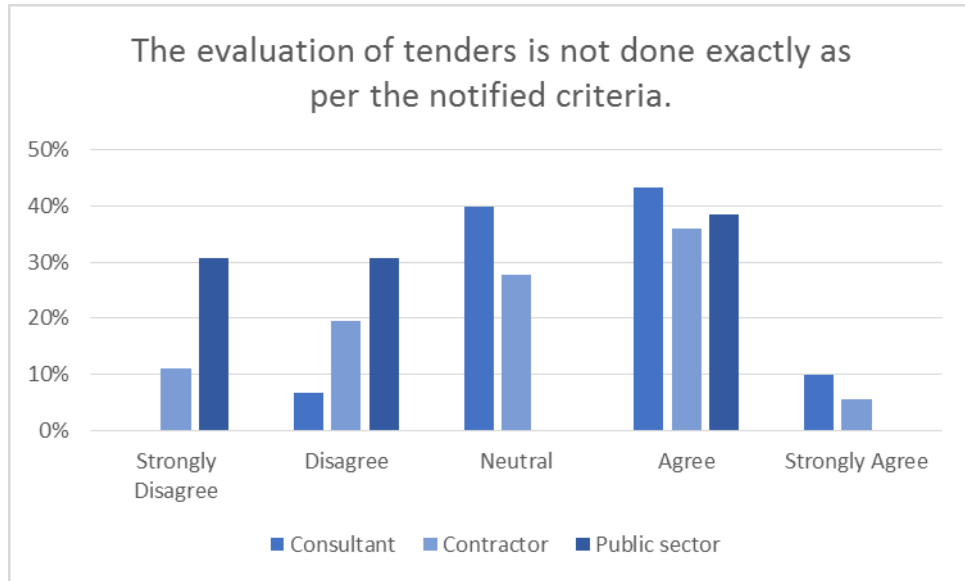
Figure 14: Response Distribution for P13

- With reference to figure 14, 60% of consultants accused contractors of making false claim as to their equipment and qualifications in order to win the bid while only 38% of contractors admit it: Le et al. (2014) classified this type of corruption as an immoral act that leads to ethical conflict between consultants and contractors and results in having problems causing loss of money and delays in the project. The public servants agree with a proportion of 53% with the consultants. It is obvious here that the contractors are avoiding self - incrimination.
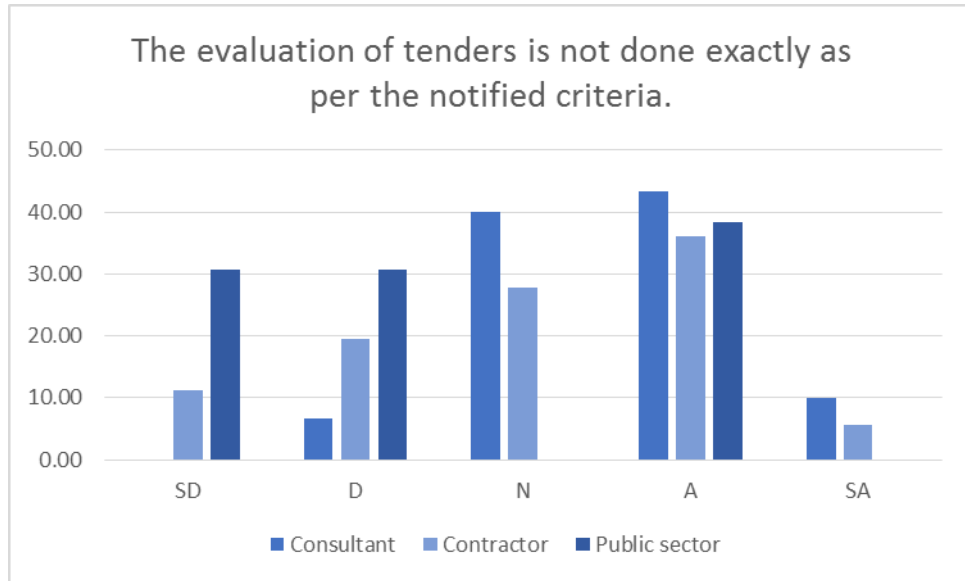
Figure 15: Response Distribution for P5

- With reference to figure 15, concerning the evaluation of tenders according to the set criteria, the contractors' opinion is divided with a slight agreement that criteria are not fully respected in evaluating the tenders whereas the majority of consultants are more extreme and forthcoming in expressing their opinion and agree on the occurrence of this problem during bid evaluation. Public servants on the other hand are clearly divided with a slight majority in disagreement as this problem concerns their duties and incriminates them in the first place.
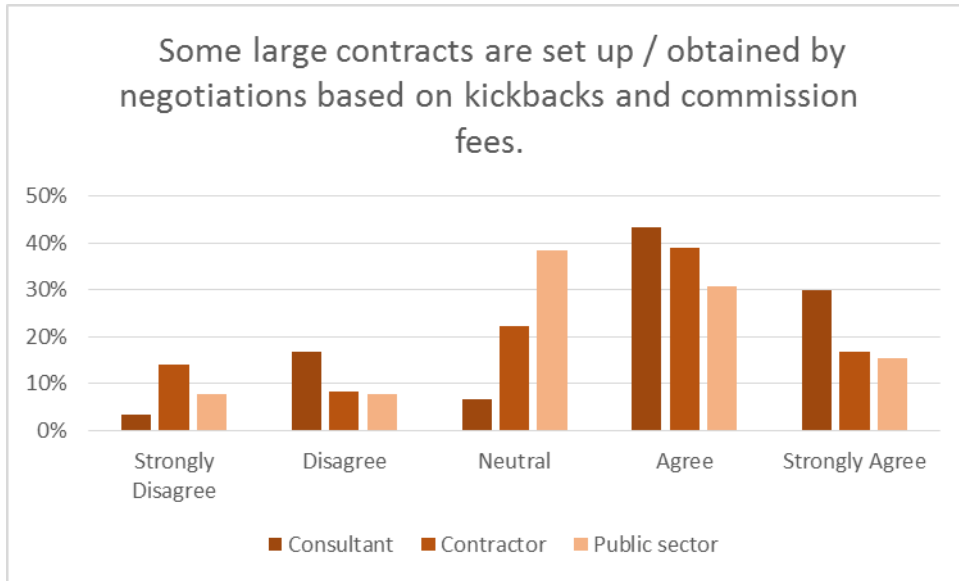
Figure 16: Response Distribution for P8
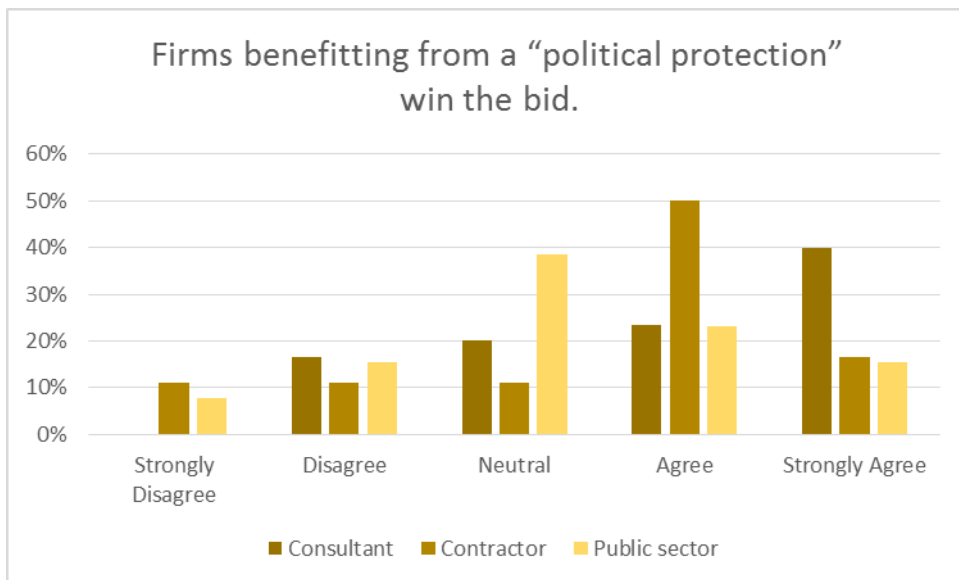
Figure 17: Response Distribution for P10
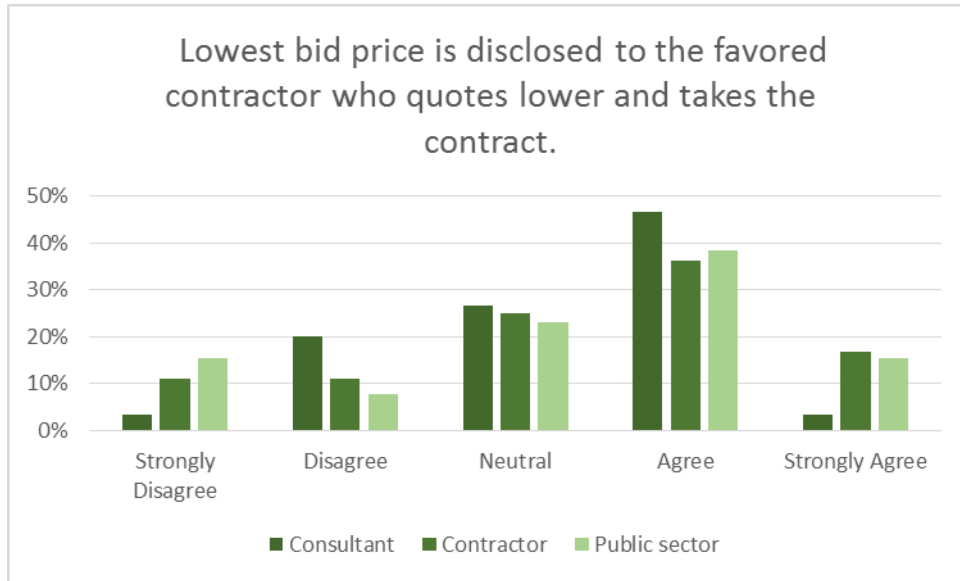
Figure 18: Response Distribution for P12

- Referring to figure 16, 17 and 18; contractors and consultants share similar views on the presence of political protection for the firms, kickbacks, and the disclosure of the lowest price to the favored contractors who may quote lower and win the bid what constitutes a clear disrespect of the legally required impartiality that should be present during the contracts' award. Sohail and Cavill (2008) have identified these under opportunities for political patronage and kickbacks.

4.3.2.3 Construction stage

As presented in Table 15, and contrary to the planning stage and contract award stage, there is significant difference in perceiving corruption in most of the problems listed in that section between consultants and contractors. By accounting for the public servants position on the problems where disagreement is observed it is possible to detect the reasons behind that on the basis of avoidance of self-incrimination by contractors.

Specs modified to accept inferior materials for the benefit of a certain firm.
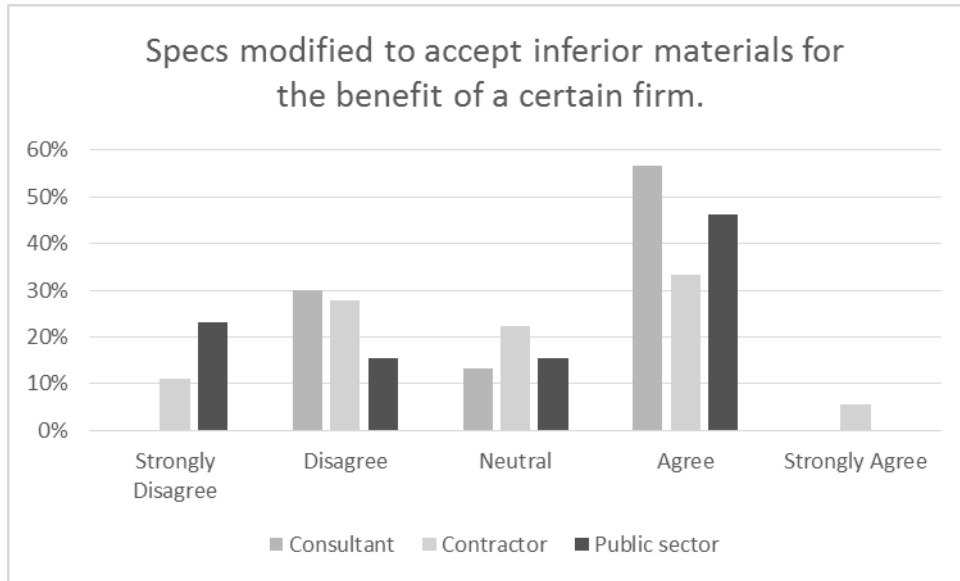
Figure 19: Response distribution for P15

- With reference to figure 19, concerning the modification of specifications to accept inferior materials, contractors and consultants share similar perceptions with consultants being more extreme in showing their agreement with this problem. One of the experts interviewed considered this issue as natural since consultants are always more theoretical and strict in construction projects than contractors who are always practical and bent on reducing the cost of construction activities in order not to compromise their profit. It is similar to what happened in Ghana as illustrated Osei-Tutu et al. (2010) who reported the presence of corruption throughout the procurement process.
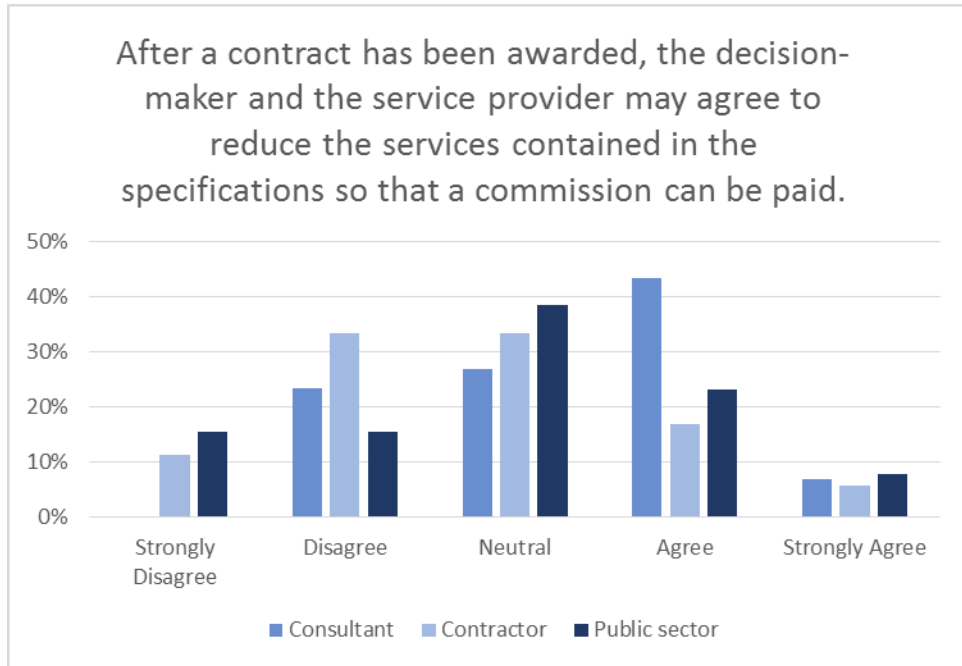
Figure 20: Response Distribution for P17
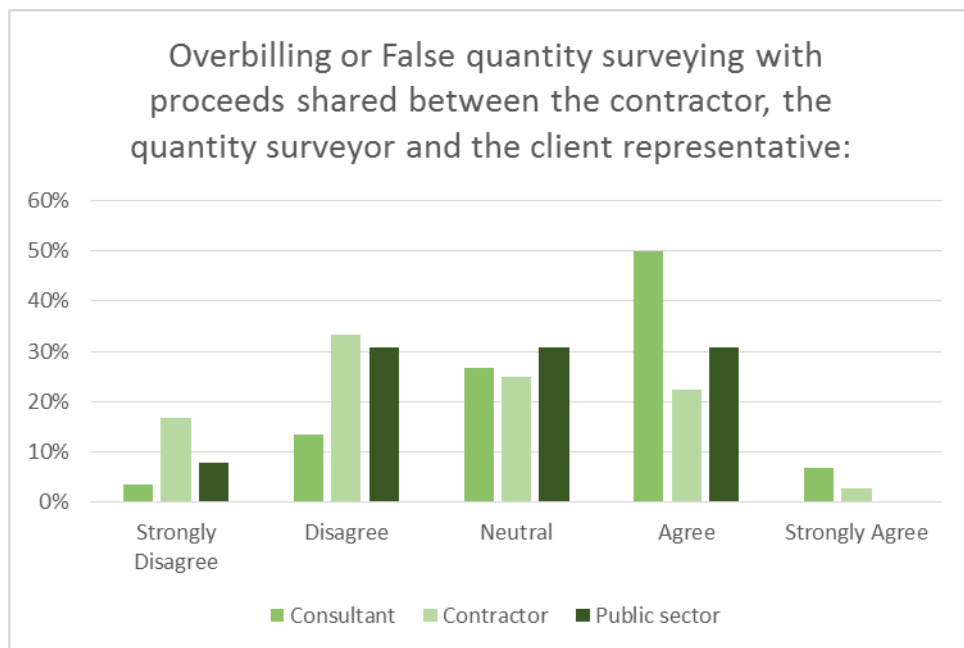
Figure 21: Response Distribution for P18

➤ With reference to figure 20 and 21, "P17- After a contract has been awarded, the decision-maker and the service provider may agree to reduce the services contained in the specifications so that a commission can be paid" and "P18- Overbilling or False quantity surveying with proceeds shared between the contractor, the quantity surveyor and the client representative" a majority of

consultants showed agreement with this statement in opposition to a distribution of opinions concerning contractors and reflecting no clear stand. Further analysis should be done to evaluate the extent of corruption present under this form.
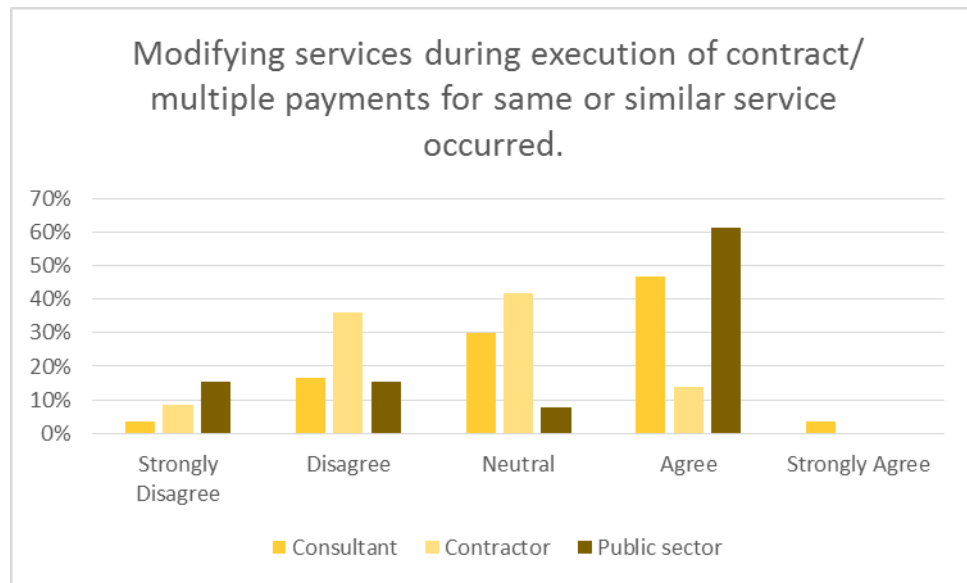
Figure 22: Response Distribution for P16

➢ With reference to figure 22, "P16- Modifying services during execution of contract/ multiple payments for same or similar service occurred" got an agreement from 56% of consultants with only 13.89% of contractors agreeing on this issue. The public employees' position is aligned with the consultants' opinion where 61.54% of officials are aware of this corrupt practice.
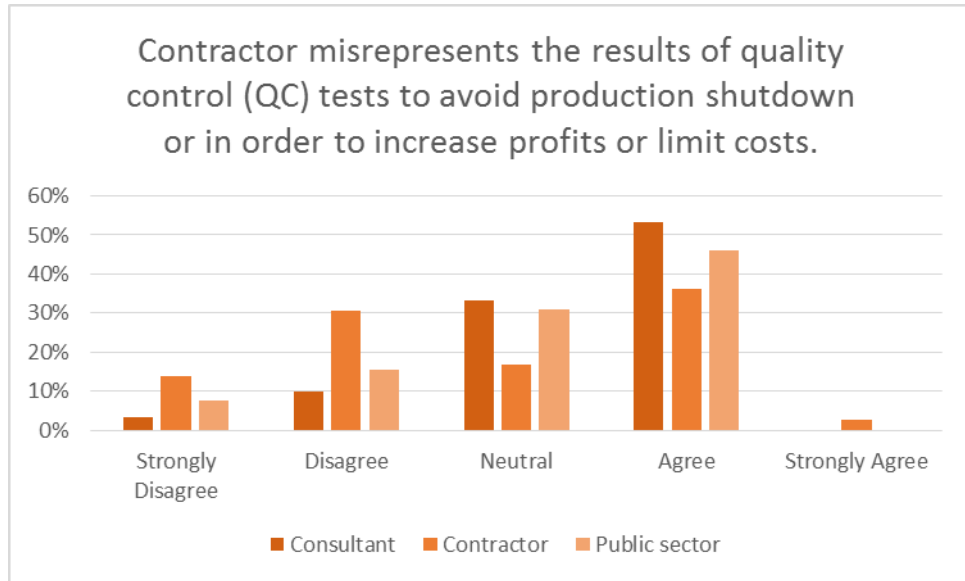
- With reference to figure 23, 53.33% of consultants agree on problem P20 "Contractor misrepresents the results of quality control (QC) tests to avoid production shutdown or in order to increase profits or limit costs" with only 38.89% agreement from the contractors group.
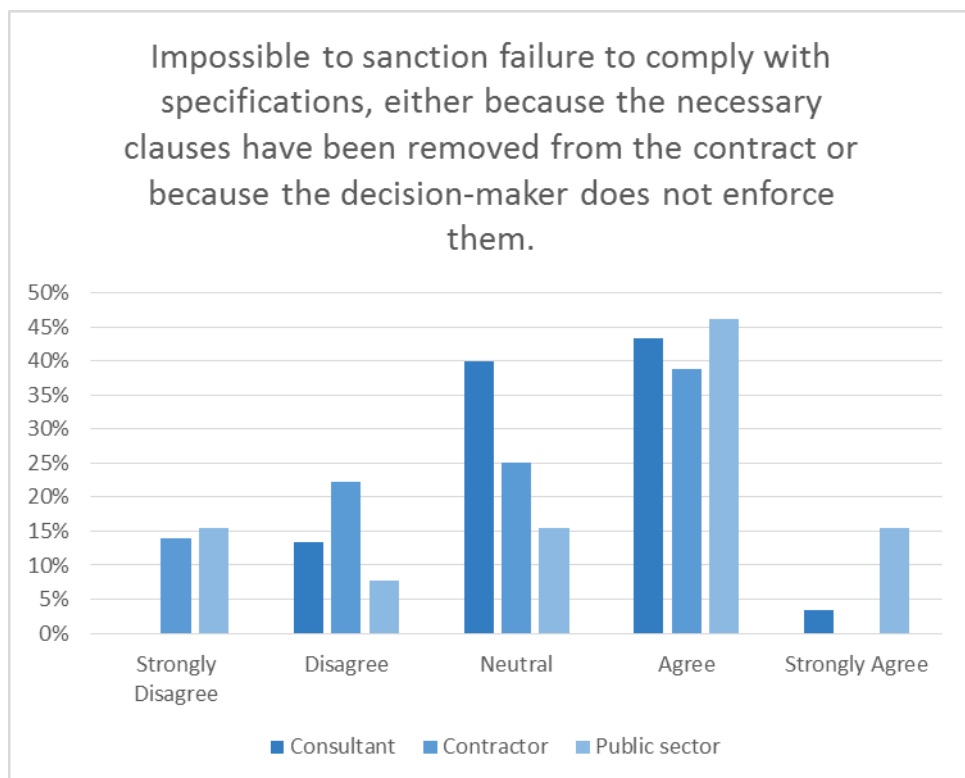
➢ With reference to figure 24, "P19- Impossible to sanction failure to comply with specifications, either because the necessary clauses have been removed from the contract or because the decision-maker does not enforce them" received up to 40% agreement from all groups with the rest of the opinions spreads over the choices of the questionnaire.

In conclusion, it is observed that all groups agree on problems related to forms of corruption extraneous to their own responsibilities and area of professional practice. Major disagreement was observed between consultants and contractors on forms of corruption relating to common practices among contractors. The latter showed disagreement on the basis of avoiding self-incrimination. The perception of public servants were generally aligned with the majority of the consultants with slight biases in particular forms of corruption relating to the actions of their political superior.

4.4 CORRELATION TEST

4.4.1 Overview

Noting that the Pearson correlation coefficient is a measure of the strength of a linear association between two variables and is denoted by r. The Pearson correlation coefficient, r, can take a range of values from +1 to -1. A value of 0 indicates that there is no relation between the two variables. The stronger the association of the two variables, the closer the Pearson correlation coefficient, r, will be to either +1 or -1, depending on whether the relationship is positive or negative." (Laerd statistics, 2019)

Table 16 below summarizes the strength of the relationship depending on the value of coefficient r following Cohen (1988)

Table 16: r values and significance

Strengh of the association	Positive r	Negative r
Small	0.1 to 0.29	-0.1 to -0.29
Medium	0.3 to 0.5	-0.3 to -0.5
Large	0.5 to 1	-0.5 to -1

In this section, a correlation test was performed on all problems presented in the questionnaire in order to test to which extent each problem was related to another by examining the similarity of the answers for each question. This will allow identifying relations between different problems and grouping them so that conclusions concerning the cause, effect, and the extent of corruption may be drawn clearly. This test is performed using SPSS.

4.4.2 Results: Correlation between identified problems.

A matrix of results relating all problems and showing their correlation is attached in Appendix C.

Table 17 summarizes problems whose answers showed high correlation (r>0.7).

Table 17: Correlation between identified problems (r value).

r value	Some large contracts are set up / obtained by negotiations based on kickbacks and commission fees	Firms benefitting from a "political protection" win the bid	Bid rigging where the pre-selected contractor wins the tender at a higher price because of contractors' collusion.	Kickbacks were asked for by decision makers and influencers
Contracts' terms and references are made to fit ONE specific contractors	0.779	0.806		
Some large contracts are set up / obtained by negotiations based on kickbacks and commission fees			0.745	0.744

r value	After a contract has been awarded, the decision-maker and the service provider may agree to reduce the services contained in the specifications so that a commission can be paid.	Impossible to sanction failure to comply with specifications, either because the necessary clauses have been removed from the contract or because the decision-maker does not enforce them.	Overbilling or False quantity surveying with proceeds shared between the contractor, the quantity surveyor and the client representative
Specs modified to accept inferior materials for the benefit of a certain firm	0.744	0.703	
Contractor misrepresents			

the results of quality control (QC) tests to avoid production shutdown or in order to increase profits or limit costs	0.743	0.742

> The first group of questions that were strongly related is P7, P8, and P10, stating the following:

- P7- Contracts' terms and references are made to fit ONE specific contractor.
- P8- Some large contracts are set up / obtained by negotiations based on kickbacks and commission fees.
- P10- Firms benefitting from "political protection" win the bid.

It can be concluded that kickbacks and commission fees are strongly related to the political protection for the firm. Political protection gets translated into securing large contracts to selected firms with the associated kickbacks to political patrons (Clientalistic relationship).

> The second group of questions that were strongly related is P8, P11 and P14 stating the following:

- P8- Some large contracts are set up / obtained by negotiations based on kickbacks and commission fees.
- P11- Bid rigging where the pre-selected contractor wins the tender at a higher price because of contractors' collusion.

- P14- Kickbacks were asked for by decision makers and influencers.

Kickbacks are not only practiced during the bid process by contractors. They may be also asked for by decision makers or influencers at later stages. Bid rigging is another type of corruption strongly related to kickbacks practiced in the bid process hence the strong correlation.

It is interesting to note that the first and second groups corresponds to interrelated activities during the contract award stage.

➢ The third group of questions that were strongly related is P15, P17, and P19 stating the following:

- P15- Specs modified to accept inferior materials for the benefit of a certain firm.

- P17- After a contract has been awarded, the decision-maker and the service provider may agree to reduce the services contained in the specifications so that a commission can be paid.

- P19- Impossible to sanction failure to comply with specifications, either because the necessary clauses have been removed from the contract or because the decision-maker does not enforce them.

There is a strong correlation between not being able to sanction failure to comply with the specifications and the tendency to accept inferior materials and to reduce the scope of services for more private gain.

➢ The fourth group of questions that were strongly correlated is P18, P19, and P20, stating the following:

- P18- Overbilling or False quantity surveying with proceeds shared between the contractor, the quantity surveyor and the client representative:

- P19- Impossible to sanction failure to comply with specifications, either because the necessary clauses have been removed from the contract or because the decision-maker does not enforce them.

- P20- Contractor misrepresents the results of quality control (QC) tests to avoid production shutdown or in order to increase profits or limit costs.

There is a strong relationship between (i) not being able to sanction failure to comply with the specification, (ii) contractors tending to make more money from overbilling some materials and (iii) misrepresenting the results of QC.

It is interesting to note that the third and fourth groups corresponds to interrelated activities during the construction stage, more specifically related to the QA/QC activities.

4.5 ANALYSIS OF THE PROPOSED SOLUTIONS

4.5.1 Suggested solutions

One of the objectives of this work is to identify and propose possible solutions for the control of corruption in the public roads construction sector. The last part of the questionnaire presented 10 possible solutions/ actions to be evaluated by the respondents in the same manner they did for the problems/acts of corruption expressing a level of agreement with each strategy presented. The frequency index was then calculated to highlight the effectiveness of each solution and its prevalence among others so that the most popular anti-corruption actions could be identified. At the end of the questionnaire, an open-ended question was added asking respondents for additional solutions to detect any ideas that may be valuable and specific for the Lebanese public works sector and not identified in the study. Table 18 presents the ranking of all measures stated in the questionnaire according to all population. All 10 solutions received agreement with the top 4 receiving strong agreement from all respondents.

ID	Ranking according to all population	Frequency index (FI)
Improving supervision during the execution of the project.	1	0.841
Empowering corruption fighting institutional mechanisms / upholding rules in the government.	2	0.823
Blacklisting contractors who are practicing any kind of bribery, bid rigging, kickbacks.	3	0.815
Improving design in order to minimize: claims by the contractors , mistakes in material quantities , usage of inferior materials …	4	0.805
Establishing independent entities to fight corruption in the construction sector.	5	0.777
Reviewing specifications and making them more practical in order to enhance the competition on the project	6	0.767
Modifying the bid evaluation system/committee.	7	0.744
A technical auditor will reduce the amount of corruption.	8	0.729
Educating different stakeholders how badly corruption affects their business.	9	0.704
Limiting the number of projects any company can benefit from over a specified period of time.	10	0.694

Table 19 below shows the top 5 solutions among all respondents and the relative

ranking by each group of protagonists.

Table 19: Top solutions seen by all populations, consultants, contractors and public servants.

Solution	Ranking	FI	Consultants Ranking	FI	Contractors ranking	FI	PS ranking	FI
Improving supervision during the execution of the project	1	0.841	2	0.847	2	0.828	1	0.862
Empowering corruption fighting institutional mechanisms / upholding rules in the government	2	0.823	3	0.820	3	0.828	2	0.815
Blacklisting contractors who are practicing any kind of bribery , bid rigging , kickbacks.	3	0.815	1	0.860	5	0.8	5	0.754
Improving design in order to minimize: claims by the contractors , mistakes in material quantities , usage of inferior materials …	4	0.805	4	0.793	4	0.817	3	0.8
Establishing independent entities to fight corruption in the construction sector	5	0.777	7	0.747	1	0.828	7	0.708

The top 5 solutions have a high-frequency index showing strong agreement with the suggested actions. This strong level of agreement was not observed in the illustration of the corresponding problem. FI values reflect a strong demand for implementing serious strategies to fight corruption even though respondents were more "shy" in agreeing on identifying the problems the sector suffers from. "Improving supervision during the execution of the project" ranked first among all experts and came first in

ranking by the public servants which clearly shows that public servants are aware of the problems in the sector. They have difficulty on their part to exercise control what makes them call for more severe and effective supervision on projects. Contractors and consultants are not so far from agreeing with the public servants' opinion. They have also ranked improving supervision second. Moreover, what clearly shows that corruption is present in the public roads projects is the demand of all groups to empower corruption fighting institutional mechanisms and uphold new rules in the government to fight corruption effectively and enhance transparency. This suggested solution ranked second above all solutions highlighting further the seriousness of corruption in Lebanon. What is also worth mentioning is that consultants' first demand is "blacklisting contractors who are practicing any kind of bribery, bid rigging, kickbacks" showing a severe resentment towards unqualified contractors who are clients of political rainmakers. In return the contractors expressed total lack of confidence in existing mechanisms and ranked highest the establishment of independent entities to fight corruption. The loss of confidence of all groups in the political leadership and the mistrust between the three protagonist groups is a serious problem.

This being said, figure 25 summarizes the situation of the Lebanese road sector industry from the respondents' perspective as follows:

Major forms of corruption

- Political interference leads to bigger corruption.
- Firms benefitting from a "political protection" win the bid.
- Some large contracts are set up / obtained by negotiations based on kickbacks and commission fees.
- The Recurring use of one company in any given field (contractor, supplier, agent….).
- Kickbacks were asked for by decision makers and influencers.

Perception of corruption at different stages

- Contract award stage : Highest level of corruption.
- Planning stage : agreement on corruption.
- Construction stage : Different views on corruption.

Recommended solution

- Improving supervision during the execution of the project.
- Empowering corruption fighting institutional mechanisms / upholding rules in the government.
- Blacklisting contractors who are practicing any kind of bribery , bid rigging , kickbacks.
- Improving design in order to minimize: claims by the contractors, mistakes in material quantities , usage of inferior materials …
- Establishing independent entities to fight corruption in the construction sector .

Figure 25: Situation of the Lebanese public roads construction sector.

4.5.2 Additional solutions

28 respondents proposed some additional solutions for the sector based on their own experience in dealing with road projects. Table 20 presents the main proposed solutions/actions and the frequency of the suggestions by project stage.

Table 20: Additional solutions

Stage	Number of suggestions	Actions
Bidding process	10	- To have a universal bid control and execution control. - To have a committee in charge of tendering and follow up the variation orders and claims with coordination with qualified consulting international firms. - A unique prequalification process gathering all administrations. - Capped project value without possibility of future variation orders. (3) - Integration of e-bidding process to enhance transparency (3)
Political interference	3	- New political class. - Independent judiciary with strict and fair application of laws. - Limit political lobbying of executive government offices.
Construction	5	- Efficient supervision by adding more staff in the public sector. (4) - Involving experts and professional syndicate/order members to assist in supervising and evaluating projects and progresses (1)
Planning	1	- Update and index unit prices to the market so that contractors are fairly priced and contractors can work properly.

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

The published literature on corruption in public works was surveyed extensively with particular attention to public roads construction to identify its various forms. 26 problems indicative of corruption were selected for testing, corresponding to the three stages of project delivery: planning, bidding/contract award and construction. Possible solutions and suggestions for improvement were also reviewed and 10 proposals for remedial measures were also selected. Problems and solutions were integrated in a questionnaire that was administered through structured interviews to a sample of 79 seasoned professionals divided into three subgroups: contractors, consultants, and public servants representing 45.5%, 38% and 16.5% of the sample respectively.

Out of the 26 problems indicative of corruption the respondents agreed clearly that 23 of them were present in Lebanon with a frequency index greater than 0.6.
The top five forms of corruption identified by the whole population surveyed were:

1- Political interference,

2- Firms with "political protection" win the bids,

3- Some large contracts are set up and awarded by negotiations based on commissions and kickbacks,

4- Recurrent use of one company in any given field,

5- Kickbacks were asked for by decision makers and influencers.

All groups ranked political interference as the top form of corruption. The top three forms of corruption were ranked similarly by contractors and consultants alike.

Differences in importance ranking were noted in the rest of the problems investigated based on the particular perception of each group and their professional bias.

The frequency distribution of the answers of the different groups to the questions revealed that the consultants are more forthcoming or extreme in expressing their opinions i.e. strongly agreeing or disagreeing while the contractors and public servants showed more reserve with their selected answers falling in the agree-disagree interval.

The public servants' perception of corruption was generally aligned with that of consultants with slight bias on particular forms of corruption related to the activities of governmental administrators and political leadership. This is probably related to the fact that public servants are assigned to their positions by the upper administration and political leadership of the institution they serve.

The respondents associated the contract award stage with the highest level of corruption in comparison with the planning and construction stages with three dominant themes: (i) external/political interference to favor one particular bidder, (ii) non-compliant procedures and (iii) contractors' collusion or false claims.

Independent t-test result results between contractors and consultants revealed close agreement on forms of corruption in the planning and contract award stages with clear disagreement on the forms of corruption proposed for the construction stage which included:

- Modifying services during execution after contract award,

- Multiple payments for same or similar service occurred,

- Overbilling or False quantity surveying,

- Impossibility to sanction failure to comply with specifications,

- Contractor misrepresenting the results of quality control (QC) tests.

The disagreement is attributed to the clear avoidance of self-incrimination by contractors given the particular focus of the survey questions on corrupt activities carried out by them during the construction stage. The opinion of public servants is mostly aligned with the consultants' which supports the proposed interpretation.

Correlation test results showed direct and strong correlation between groups of problems that address one overarching topic such as (i) political intervention/protection, (ii) bid rigging/kickbacks, (iii) compliance with contractual conditions and specifications and (iv) fraud in quantity or quality of materials. This allows the identification of clusters of corrupt activities which can receive similar mitigation.

Respondents agreed very clearly with all 10 solutions/remedial actions proposed, with improving supervision and empowering institutional mechanisms for fighting corruption coming on top. Suggestions for additional corruption fighting actions not covered by the proposed solutions concentrated on (a) improving contract award mechanisms and fighting bid rigging and (b) political reform and an independent judiciary.

Finally, the work presented in this thesis is the first of its kind for Lebanon, and has provided concrete evidence for the existence of various forms of corruption in public road construction projects. These results lay the basis for developing a corruption fighting strategy and offer possible low hanging fruits such as presented in the selected solutions.

Possible low hanging fruits are:

1- Educating different stakeholders how badly corruption affects their business can be one of the easiest and fastest to implement activities. The information is available in the published literature and training and education can be offered or even mandated for key personnel. The training would highlight areas of corruption and teach protagonists to identify red flags which they could then use to report alleged corruption to relevant authorities and the press. This activity can go alongside the revitalization of corruption fighting authorities and institutional mechanisms such the Ombudsman of the Republic and the Anti-Corruption Commission both mandated by Lebanese law and yet to be appointed by the Council of Ministers.

2- Limiting the number of projects any company can benefit from over a specified period of time can be achieved by simply publishing the results and details of all contract awards in all public institutions with the names of the economic beneficiaries of each company identified. The full transparency exercise would allow immediate identification and sanctioning of the cartelization of public procurement, making the determination of limits very easy. Full transparency and publication is also mandated by the recently published law on access to information but has yet to be implemented. The

Office of the Minister for Administrative Reform, OMSAR, is the natural institution to be charged with this mission of information and transparency.

3- The implementation of a unified e-bidding process for the Lebanese Government would also address very easily the proposed solution under modifying the bid process, at least partially in what concerns publications of requests for offers, deadlines and other formalities. An in-depth review would take longer, but the first step is a low hanging fruit indeed.

5.2 RECOMMENDATIONS FOR FUTURE WORK

Possible avenues to further develop the work started in this thesis include:

1. Investigating the root causes of corrupt practices in roads projects.

2. Quantifying the impact of corrupt practices on roads projects in terms of costs, quality and delays.

3. Studying the cost of roads construction per km in Lebanon for various projects and establish a corruption metrics.

4. Studying the impact of changing the bid evaluation system and contract award process on corruption.

5. Expanding the identification of corrupt acts and their perception among the various stakeholders of the public works sector at large.

6. Developing and testing an action plan to limit corruption consisting of short, middle and long term targets.

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APPENDIX A: Types of corruption identified in the literature survey

The following tables list the corruption types identified in previous studies and the sources citing them. These were used as source information for the survey in this work.

Table 21: Corruption forms by Bueb & Ehlermann-Cache (2005)

Phase	Form
Identification of needs	Modified or falsified needs
Identification of needs	Unnecessary, falsified or subjective studies
Definition of specifications	Misevaluated project estimate
Definition of specifications	Preference for a single supplier
Definition of specifications	Inaccurate data
Definition of specifications	Excessive specifications,
Definition of specifications	Imposed requirements for maintenance
Awarding of the contract	Split contracts
Awarding of the contract	Reduced publicity
Awarding of the contract	Misuse of bid procedure
Awarding of the contract	Biased criteria in selection of winners
Awarding of the contract	Inability or failure to apply penalties
Awarding of the contract	Non-enforcement of penalty clauses
Awarding of the contract	Omission of mandatory clauses
Performance of the contract	Misappropriation of supplies
Performance of the contract	Performance of works via multi-level sub-contracting
Performance of the contract	Multiple payments
Performance of the contract	Inappropriate changes
Performance of the contract	Irregular service provision
Performance of the contract	Improper or undisclosed disposal of used equipment
Performance of the contract	Changed orders
Performance of the contract	Discounts

Table 22: Corruption forms by Sohail & Cavill (2008)

Phase	Form
Project selection	• Corruption can negatively affect the selection of projects. For example, corruption can divert resources away from social sectors and toward major infrastructure projects. • Corruption may also encourage the selection of uneconomical projects because of opportunities for financial kickbacks and political patronage.
Planning stages	• Project used as vote winners/opportunities for personal gain not on basis of priority/ availability of financial resources. • Planning in favor of high value infrastructure _white elephant projects_ and against the interest of the poor. • Project requirements may be overstated or tailored to fit one specific bidder.
Inspection stages	• Weak oversight and supervision mechanisms have been created that would prevent detection of fraud and corruption. • Kickbacks can be given to persuade inspectors to turn a blind eye to slow implementation of projects, unfulfilled contract requirements, and other instances of malpractice.
Design	• Corrupt selection of consultants for feasibility studies, preparation of specifications/bid documents. • Overdesigned and overpriced projects to increase potential corrupt earnings during implementation. • Bribe for favorable environmental impact assessment/planning proposal/approval. • Project design has been manipulated to benefit particular suppliers, consultants, contractors, and other private parties. • The timing of the project has been altered to suit vested interests.
Bid and contract signing stage	• Political parties levy large rents on international businesses in return for government contracts. • Officials take percentages on government contracts. • Officials receive excessive "hospitality" from government contractors and benefits in kind. • Kickbacks for construction and supply contracts. • Lack of competitive/inequitable contract practices. • Inappropriate bidding procedures; excessively short bidding time or insufficient or inadequate advertising of tender. • Corrupt practice on the part of bidders _e.g., unjustified complaints, misleading bids, etc._. • Collusion among firms or between public officials and bidders. • Bid rigging in construction contracts can be facilitated by corrupt project managers and quantity surveyors _people who are supposed to be policing contracts and making sure the clients get value for money_. • Compensation payments included in the tender price: when two firms collude, and one prices itself out of one of the jobs and receives a compensation payment from the other as a reward. • Cash-plus contracts enable unscrupulous firms to inflate the value of the contract • The entrance fee, for example, a public authority agrees to give a private company the contract, provided that the company pays a fee. The company that pays the highest entrance fee wins the concession.
Construction	• Changing subcontract party after receiving bribes. • Cutting corners, ignoring rules, bypassing procedures. • Payment for equipment, materials or services which were not supplied. • The provision of equipment or goods of lower than specified quality _typical examples include lesser cement or steel reinforcements_. • Concealing substandard work. • Bribe the relevant official to certify that the work was done according to specification. • Nonimplementation. • Unjustified complaints from contractors as a way to obtain unjustified contract price increases. • Duplication of payments, alteration of invoices, lack of supporting records, ineligible payments, overbilling, misuse of funds _i.e. for purposes other than those aligned to project needs_, misappropriation of discounts from suppliers/contractors, unauthorized payments, etc. • Unauthorized use of project property. • Theft of materials, equipment, or services. • Entrepreneurs and brokers that exist as "fixers" facilitating relations between government and business players and negotiate the various administrative and legal steps.
Service delivery	• Ghost/absent workers. • Siphoning off supplies to market. • Favoritism in hiring/promotions. • Use of contacts/money to get better/faster service or to prevent delays.

	• Elite capture of infrastructure services.
Maintenance and management stages	• Corruption in procurement of equipment and spare parts. • Withholding needed approval/signatures of gifts/favors. • Corruption increases costs meaning lack of resources for O&M. • Bribes to win O&M contracts/personnel appointments. • Lower standard of construction creates need for expensive repair and maintenance.

Table 23: Corruption forms by Sichombo, Muya, Shakantu, Kaliba (2009)

Phase	Form
Planning up to tender stage	Collusion
Planning up to tender stage	Manipulation of prequalification by consultant
Planning up to tender stage	Extra quotations for price comparison
Planning up to tender stage	Non disclosure of interest in favoured companies
Planning up to tender stage	Non disclosure of financial status
Planning up to tender stage	Fraudulent qualifications
Planning up to tender stage	Initiation of a large complex project
Contract execution	Supplying inferior cheap material
Contract execution	False work certification
Contract execution	Increased variation claim
Contract execution	Delayed payment
Contract execution	Extortion by project owners' accountant

Table 24: Corruption forms by Osei-Tutu, Badu & Owusu-Manu (2010)

Form
Conflict of interest
Bribery
Embezzlement
Kickbacks
Tender manipulation
Fraud

Phase	Form
Immorality	The work is not executed as per original design accorded.
Immorality	Work is executed without the availability of funds for the said purpose
Immorality	The changes, especially in abnormally high rated and high value items, are not properly monitored and verified
Immorality	Contractors provide false certificates in bidding
Immorality	Substitution of unqualified materials in construction
Immorality	Site supervisor neglects duties for taking bribe from contractor
Unfairness	The consultant is not appointed after proper publicity and open competition
Unfairness	The criteria adopted in prequalification of consultant are restrictive and benefit only few consultants
Unfairness	The selection of consultant not done by appropriate Authority
Unfairness	The criteria for selection of contractor are restrictive and benefit only few contractors
Unfairness	The conditions and specifications are relaxed in favor of contractor to whom the work is being awarded
Unfairness	Confidential information of bidding is disclosed to a specific bidder
Opacity	Adequate and wide publicity is not given to tender
Opacity	Adequate time for submission of tender or offer not Given
Opacity	The evaluation of tenders is not done exactly as per the notified criteria
Opacity	The negotiation on tender not done as per laid down Guidelines
Opacity	A large project should have called for bids is split into several small projects and contracted without bidding
Procedural violation	Administrative approval and financial sanction not taken to execute the work
Procedural violation	Lack of the sanctioned financial provisions from the Government
Procedural violation	Work is not executed for the same purpose for which the sanction was accorded
Procedural violation	The proper record of hindrances is not being maintained from the beginning
Contractual violation	Escalation clause is not applied correctly for admissible payment
Contractual violation	Compliance with conditions regarding deployment of technical staff not being followed by contractor
Contractual violation	The work order or supply order is not placed within justified rates

APPENDIX B: Survey Questions

A- GENERAL INFORMATION

✓ Name of employer / business

_____
_____
_____
_____

✓ What is your current position in your organization?

Owner   Middle management   Senior management

☐   ☐   ☐

✓ Which sector do you belong to?

Consulting   Contracting   Public Sector

☐   ☐   ☐

✓ What is your highest level of education?

High School   Bachelor   Masters   PhD

☐   ☐   ☐   ☐

✓ Years of experience?

1-5   5-10   >10

☐   ☐   ☐

✓ How many public works projects (roads projects) have you been involved in during your career?

1-5   5-10   >10

☐   ☐   ☐

B – Problems that the Lebanese public works roads construction sector may suffer from:

✓ At the planning stage, overestimating needs is done so that projects can be launched which are unnecessary or bigger than planned.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
☐	☐	☐	☐	☐

✓ Splitting a large contract into several smaller ones that are not subject to public procurement regulations.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
☐	☐	☐	☐	☐

✓ Reduced publicity, such as publication of contracts in a journal with limited circulation or in domestic journals only.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
☐	☐	☐	☐	☐

✓ Adequate time for submission of tender or offer is not given.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
☐	☐	☐	☐	☐

✓ The evaluation of tenders is not done exactly as per the notified criteria.

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
☐	☐	☐	☐	☐

✓ Contract's terms and references are vague or incomplete:

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
☐	☐	☐	☐	☐

✓ Contracts' terms and references are made to fit ONE specific contractors :

Strongly agree	Agree	Neutral	Disagree	Strongly disagree
☐	☐	☐	☐	☐

✓ Some large contracts are set up / obtained by negotiations based on kickbacks and commission fees:

Strongly agree   Agree   Neutral   Disagree   Strongly disag

☐   ☐   ☐   ☐   ☐

✓ The Recurring use of one company in any given field (contractor, supplier, agent….)

Strongly agree   Agree   Neutral   Disagree   Strongly disag

☐   ☐   ☐   ☐   ☐

✓ Firms benefitting from a "political protection" win the bid:

Strongly agree   Agree   Neutral   Disagree   Strongly disag

☐   ☐   ☐   ☐   ☐

✓ Bid rigging where the pre-selected contractor wins the tender at a higher price because of contractors' collusion.

Strongly agree   Agree   Neutral   Disagree   Strongly disag

☐   ☐   ☐   ☐   ☐

✓ Lowest bid price is disclosed to the favored contractor who quotes lower and takes the contract:

Strongly agree   Agree   Neutral   Disagree   Strongly disag

☐   ☐   ☐   ☐   ☐

✓ Contractors make false claims as to their equipment, employees , company's qualifications in order to win the bid:

Strongly agree   Agree   Neutral   Disagree   Strongly disag

☐   ☐   ☐   ☐   ☐

✓ Kickbacks were asked for by decision makers and influencers:

Strongly agree   Agree   Neutral   Disagree   Strongly disag

☐   ☐   ☐   ☐   ☐

✓ Specs modified to accept inferior materials for the benefit of a certain firm?

Strongly agree   Agree   Neutral   Disagree   Strongly
disag☐   ☐   ☐   ☐   ☐

✓ Modifying services during execution of contract/ multiple payments for same or similar service occurred.

Strongly agree   Agree   Neutral   Disagree   Strongly
disag☐   ☐   ☐   ☐   ☐

✓ After a contract has been awarded, the decision-maker and the service provider may agree to reduce the services contained in the specifications so that a commission can be paid.

Strongly agree   Agree   Neutral   Disagree   Strongly
disag☐   ☐   ☐   ☐   ☐

✓ Overbilling or False quantity surveying with proceeds shared between the contractor, the quantity surveyor and the client representative:

Strongly agree   Agree   Neutral   Disagree   Strongly
disag☐   ☐   ☐   ☐   ☐

✓ Impossible to sanction failure to comply with specifications, either because the necessary clauses have been removed from the contract or because the decision-maker does not enforce them.

Strongly agree   Agree   Neutral   Disagree   Strongly
disag☐   ☐   ☐   ☐   ☐

✓ Contractor misrepresents the results of quality control (QC) tests to avoid production shutdown or in order to increase profits or limit costs:

Strongly agree   Agree   Neutral   Disagree   Strongly
disag☐   ☐   ☐   ☐   ☐

✓ State if the following features have strong correlation with corruption (answer by Strongly agree, agree , disagree, strongly disagree , Strongly disagree)

    Size of the project : _____

    Uniqueness of the project : _____

    Political interferences : _____

    Different number of phases : _____

    Frequency/ number of available projects : _____

✓ Do you think that the government goes towards large capital projects in roads instead of systematic maintenance of existing networks?

Strongly agree   Agree   Neutral   Disagree   Strongly disagree

☐   ☐   ☐   ☐   ☐

✓ Are our roads maintained frequently? IF yes, how often?

YES   NO

☐   ☐

_____

C- Possible Solutions

✓ A technical auditor will reduce the amount of corruption:

Strongly Agree   Agree   Neutral   Disagree   Strongly Disagree

☐   ☐   ☐   ☐   ☐

✓ Educating different stakeholders how badly corruption affects their business:

Strongly Agree   Agree   Neutral   Disagree   Strongly Disagree

☐   ☐   ☐   ☐   ☐

✓ Establishing independent entities to fight corruption in the construction sector :

Strongly Agree   Agree   Neutral   Disagree   Strongly Disagree

☐   ☐   ☐   ☐   ☐

✓ Improving design in order to minimize: claims by the contractors , mistakes in material quantities , usage of inferior materials …

Strongly Agree   Agree   Neutral   Disagree   Strongly Disag

☐   ☐   ☐   ☐   ☐

✓ Improving supervision during the execution of the project :

Strongly Agree   Agree   Neutral   Disagree   Strongly Disag

☐   ☐   ☐   ☐   ☐

✓ Reviewing specifications and making them more practical in order to enhance the competition on the project :

Strongly Agree   Agree   Neutral   Disagree   Strongly Disag

☐   ☐   ☐   ☐   ☐

✓ Modifying the bid evaluation system/committee

Strongly Agree   Agree   Neutral   Disagree   Strongly Disag

☐   ☐   ☐   ☐   ☐

✓ Empowering corruption fighting institutional mechanisms / upholding rules in the government :

Strongly Agree   Agree   Neutral   Disagree   Strongly Disag

☐   ☐   ☐   ☐   ☐

✓ Blacklisting contractors who are practicing any kind of bribery , bid rigging , kickbacks

Strongly Agree   Agree   Neutral   Disagree   Strongly D☐ e

☐   ☐   ☐   ☐   ☐

✓ Limiting the number of projects any company can benefit from over a specified period of time :

Strongly Agree   Agree   Neutral   Disagree   Strongly Disagree

☐   ☐   ☐   ☐   ☐

✓ Additional solutions to fight corruption in this field

_____
_____
_____
_____
_____

APPENDIX C: Statistical analysis results

Table 26: Percent of agreement/disagreement table.

Consultants Disagreement	Contractors Disagreement	Public Servants Disagreement	Total	ID	Consultants Agreement	Contractors Agreement	Public Servants Agreement	Total
13.33	27.78	53.85	26.58	P1	40.00	33.33	38.46	36.71
13.33	30.56	38.46	25.32	P2	70.00	47.22	38.46	54.43
16.67	30.56	53.85	29.11	P3	63.33	44.44	46.15	51.90
36.67	30.56	53.85	36.71	P4	50.00	44.44	38.46	45.57
6.67	30.56	61.54	26.58	P5	53.33	41.67	38.46	45.57
30.00	33.33	53.85	35.44	P6	46.67	41.67	46.15	44.30
30.00	38.89	38.46	35.44	P7	56.67	38.89	53.85	48.10
20.00	22.22	15.38	20.25	P8	73.33	55.56	46.15	60.76
16.67	22.22	15.38	18.99	P9	63.33	47.22	69.23	56.96
16.67	22.22	23.08	20.25	P10	63.33	66.67	38.46	60.76
6.67	30.56	23.08	20.25	P11	43.33	50.00	53.85	48.10
23.33	22.22	23.08	22.78	P12	50.00	52.78	53.85	51.90
20.00	36.11	30.77	29.11	P13	60.00	38.89	53.85	49.37
10.00	16.67	23.08	15.19	P14	63.33	47.22	53.85	54.43
30.00	38.89	38.46	35.44	P15	56.67	38.89	46.15	46.84
20.00	44.44	30.77	32.91	P16	50.00	13.89	61.54	35.44
23.33	44.44	30.77	34.18	P17	50.00	22.22	30.77	34.18
16.67	50.00	38.46	35.44	P18	56.67	25.00	30.77	37.97
13.33	36.11	23.08	25.32	P19	46.67	38.89	61.54	45.57
13.33	44.44	23.08	29.11	P20	53.33	38.89	46.15	45.57
16.67	36.11	15.38	25.32	P21	56.67	50.00	61.54	54.43
33.33	33.33	23.08	31.65	P22	40.00	52.78	61.54	49.37
10.00	13.89	7.69	11.39	P23	73.33	75.00	76.92	74.68
26.67	30.56	15.38	26.58	P24	50.00	47.22	61.54	50.63
20.00	36.11	46.15	31.65	P25	53.33	41.67	38.46	45.57
10.00	38.89	46.15	29.11	P26	70.00	36.11	38.46	49.37
10.00	22.22	23.08	17.72	S1	70.00	69.44	76.92	70.89
23.33	16.67	30.77	21.52	S2	53.33	61.11	69.23	59.49
10.00	2.78	23.08	8.86	S3	66.67	83.33	69.23	74.68
3.33	2.78	15.38	5.06	S4	83.33	80.56	84.62	82.28
0.00	5.56	7.69	3.80	S5	93.33	83.33	92.31	88.61
3.33	13.89	23.08	11.39	S6	76.67	80.56	76.92	78.48
0.00	8.33	30.77	8.86	S7	70.00	75.00	53.85	69.62
6.67	2.78	7.69	5.06	S8	83.33	86.11	84.62	84.81
0.00	11.11	23.08	8.86	S9	96.67	72.22	76.92	82.28
10.00	25.00	38.46	21.52	S10	53.33	58.33	53.85	55.70

* This table shows percentage agreement or disagreement per problem for each category of respondents for figures 6 till 24.

Table 27: Independent t-test for problems.

		F	Sig	t	Df	Sig(2-tailed)	Mean difference	Std. Error Difference
P1	Equal variances assumed	.935	.337	.849	64	.399	.19444	.22911
	Equal variances not assumed			.867	63.822	.389	.19444	.22421
P2	Equal variances assumed	5.286	.025	1.888	64	.064	.46667	.24714
	Equal variances not assumed			1.946	62.613	.056	.46667	.23982
P3	Equal variances assumed	.048	.827	1.646	64	.105	.41111	.24981
	Equal variances not assumed			1.646	61.971	.105	.41111	.24971
P4	Equal variances assumed	.000	.986	-.376	64	.708	-.11111	.29540
	Equal variances not assumed			-.377	62.442	.707	-.11111	.29465
P5	Equal variances assumed	3.058	.085	2.113	64	.038	.51111	.24185
	Equal variances not assumed			2.183	62.025	.033	.51111	.23408
P6	Equal variances assumed	.203	.654	.476	64	.635	.12222	.25654
	Equal variances not assumed			.481	63.684	.632	.12222	.25384
P7	Equal variances assumed	.028	.867	1.046	64	.300	.33889	.32400
	Equal variances not assumed			1.047	62.204	.299	.33889	.32353

P8	Equal variances assumed	.735	.394	1.456	64	.150	.43889	.30135
	Equal variances not assumed			1.469	63.449	.147	.43889	.29881
P9	Equal variances assumed	.280	.599	1.685	64	.097	.44444	.26382
	Equal variances not assumed			1.704	63.751	.093	.44444	.26086
P10	Equal variances assumed	.039	.845	1.248	64	.217	.36667	.29391
	Equal variances not assumed			1.257	63.289	.213	.36667	.29177
P11	Equal variances assumed	4.062	.048	1.462	64	.149	.40000	.27355
	Equal variances not assumed			1.506	62.681	.137	.40000	.26554
P12	Equal variances assumed	2.016	.161	-.346	64	.731	-.09444	.27321
	Equal variances not assumed			-.354	63.671	.725	-.09444	.26692
P13	Equal variances assumed	.010	.919	2.110	64	.039	.53889	.25545
	Equal variances not assumed			2.119	62.804	.038	.53889	.25433
P14	Equal variances assumed	1.098	.299	1.363	64	.178	.29444	.21595
	Equal variances not assumed			1.390	63.959	.169	.29444	.21185
P15	Equal variances assumed	1.029	.314	1.249	64	.216	.32222	.25808
	Equal variances not assumed			1.275	63.858	.207	.32222	.25269

P16	Equal variances assumed	.258	.613	3.189	64	.002	.68889	.21599
	Equal variances not assumed			3.164	59.561	.002	.68889	.21776
P17	Equal variances assumed	.242	.624	2.474	64	.016	.61111	.24699
	Equal variances not assumed			2.506	63.857	.015	.61111	.24389
P18	Equal variances assumed	1.681	.199	3.229	64	.002	.82222	.25467
	Equal variances not assumed			3.278	63.973	.002	.82222	.25086
P19	Equal variances assumed	4.764	.033	2.021	64	.047	.47778	.23639
	Equal variances not assumed			2.086	62.328	.041	.47778	.22909
P20	Equal variances assumed	8.251	.006	2.125	64	.037	.53333	.25098
	Equal variances not assumed			2.194	62.217	.032	.53333	.24311
P21	Equal variances assumed	2.510	.118	1.591	64	.116	.42778	.26881
	Equal variances not assumed			1.619	63.998	.110	.42778	.26418
P22	Equal variances assumed	1.408	.240	-.175	64	.862	-.05000	.28581
	Equal variances not assumed			-.177	63.889	.860	-.05000	.28207
P23	Equal variances assumed	.056	.813	.986	64	.328	.23889	.24234
	Equal variances not assumed			.992	63.103	.325	.23889	.24087

		F	Sig	T	Df	Sig(2-tailed)	Mean difference	Std. Error Difference
P24	Equal variances assumed	.090	.765	.659	64	.512	.16111	.24450
	Equal variances not assumed			.663	63.117	.510	.16111	.24299
P25	Equal variances assumed	.188	.666	1.395	64	.168	.31667	.22697
	Equal variances not assumed			1.401	62.793	.166	.31667	.22599
P26	Equal variances assumed	3.856	.054	2.196	64	.032	.51667	.23523
	Equal variances not assumed			2.248	63.679	.028	.51667	.22983

Table 28: Independent t-test for solutions/actions.

		F	Sig	T	Df	Sig(2-tailed)	Mean difference	Std. Error Difference
S1	Equal variances assumed	5.793	.019	.444	64	.658	.11111	.25019
	Equal variances not assumed			.462	60.341	.646	.11111	.24074
S2	Equal variances assumed	.262	.611	-.731	64	.467	-.17778	.24316
	Equal variances not assumed			-.728	60.848	.469	-.17778	.24412
S3	Equal variances assumed	.859	.357	-2.021	64	.047	-.40556	.20067
	Equal variances not assumed			-1.997	58.264	.051	-.40556	.20310
S4	Equal variances assumed	1.718	.195	-.650	64	.518	-.11667	.17943

		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
	Equal variances not assumed			-.659	63.876	.512	-.11667	.17712
S5	Equal variances assumed	2.049	.157	.527	64	.600	.09444	.17931
	Equal variances not assumed			.545	61.755	.588	.09444	.17337
S6	Equal variances assumed	2.027	.159	.170	64	.866	.03889	.22918
	Equal variances not assumed			.176	61.149	.861	.03889	.22110
S7	Equal variances assumed	.192	.663	.773	64	.442	.15000	.19409
	Equal variances not assumed			.785	63.978	.436	.15000	.19115
S8	Equal variances assumed	.032	.860	-.188	64	.852	-.03889	.20730
	Equal variances not assumed			-.187	61.559	.852	-.03889	.20756
S9	Equal variances assumed	7.503	.008	1.369	64	.176	.30000	.21916
	Equal variances not assumed			1.449	52.692	.153	.30000	.20706
S10	Equal variances assumed	5.738	.020	.022	64	.982	.00556	.25187
	Equal variances not assumed			.023	62.465	.982	.00556	.24424

Table 29: Correlation test for problems.

		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25	P26
P1	Pearson Correlation	1	.052	.022	.142	-.184	.011	-.021	-.046	.036	-.023	.086	-.111	-.235*	-.055	.099	-.059	-.064	-.213	-.163	-.188	-.102	-.057	-.053	-.267*	.091	.150
	Sig. (2-tailed)		.652	.846	.211	.104	.926	.853	.684	.751	.841	.452	.329	.037	.630	.385	.603	.576	.060	.151	.098	.370	.620	.644	.017	.427	.186
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P2	Pearson Correlation	.052	1	.369**	.221	.538**	.424**	.367**	.343**	.358**	.444**	.420**	.208	.367**	.381**	.370**	.287*	.302**	.348**	.411**	.380**	.227*	.234*	.228*	.132	.159	.080
	Sig. (2-tailed)	.652		.001	.050	.000	.000	.001	.002	.001	.000	.000	.066	.001	.001	.001	.010	.007	.002	.000	.001	.044	.038	.044	.245	.162	.481
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P3	Pearson Correlation	.022	.369**	1	.383**	.376**	.430**	.593**	.515**	.459**	.542**	.510**	.563**	.482**	.570**	.505**	.357**	.495**	.379**	.420**	.435**	.266*	.296**	.282*	.186	.348**	.133
	Sig. (2-tailed)	.846	.001		.000	.001	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.001	.000	.001	.000	.000	.018	.008	.012	.101	.002	.242
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P4	Pearson Correlation	.142	.221	.383**	1	.418**	.500**	.412**	.295**	.205	.337**	.301**	.571**	.363**	.458**	.297**	.295**	.187	.176	.295**	.217	.059	.116	.089	-.080	.024	.005
	Sig. (2-tailed)	.211	.050	.000		.000	.000	.000	.008	.070	.002	.007	.000	.001	.000	.008	.008	.099	.122	.008	.055	.606	.309	.436	.482	.832	.966
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P5	Pearson Correlation	-.184	.538**	.376**	.418**	1	.675**	.488**	.451**	.410**	.595**	.387**	.333**	.609**	.560**	.499**	.458**	.516**	.540**	.513**	.510**	.238*	.379**	.240*	.224*	.263*	.160
	Sig. (2-tailed)	.104	.000	.001	.000		.000	.000	.000	.000	.000	.000	.003	.000	.000	.000	.000	.000	.000	.000	.000	.034	.001	.033	.047	.019	.159
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P6	Pearson Correlation	.011	.424**	.430**	.500**	.675**	1	.494**	.419**	.406**	.525**	.357**	.413**	.504**	.510**	.575**	.434**	.439**	.421**	.444**	.504**	.222*	.354**	.181	.101	.268*	.070
	Sig. (2-tailed)	.926	.000	.000	.000	.000		.000	.000	.000	.000	.001	.000	.000	.000	.000	.000	.000	.000	.000	.000	.049	.001	.111	.377	.017	.541
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P7	Pearson Correlation	-.021	.367**	.593**	.412**	.488**	.494**	1	.779**	.661**	.806**	.692**	.491**	.578**	.690**	.709**	.554**	.647**	.609**	.625**	.627**	.342**	.275*	.492**	.321**	.425**	.297**
	Sig. (2-tailed)	.853	.001	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.002	.014	.000	.004	.000	.008
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P8	Pearson Correlation	-.046	.343**	.515**	.295**	.451**	.419**	.779**	1	.629**	.775**	.745**	.374**	.500**	.744**	.694**	.559**	.641**	.667**	.590**	.706**	.472**	.312**	.423**	.356**	.334**	.254*
	Sig. (2-tailed)	.684	.002	.000	.008	.000	.000	.000		.000	.000	.000	.001	.000	.000	.000	.000	.000	.000	.000	.000	.000	.005	.000	.001	.003	.024
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P9	Pearson Correlation	.036	.358**	.459**	.205	.410**	.406**	.661**	.629**	1	.632**	.695**	.290**	.489**	.608**	.665**	.488**	.601**	.500**	.673**	.570**	.333**	.323**	.512**	.325**	.476**	.257*
	Sig. (2-tailed)	.751	.001	.000	.070	.000	.000	.000	.000		.000	.000	.010	.000	.000	.000	.000	.000	.000	.000	.000	.003	.004	.000	.004	.000	.022
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P10	Pearson Correlation	-.023	.444**	.542**	.337**	.595**	.525**	.806**	.775**	.632**	1	.670**	.478**	.562**	.693**	.699**	.480**	.609**	.617**	.600**	.657**	.399**	.369**	.425**	.335**	.439**	.360**
	Sig. (2-tailed)	.841	.000	.000	.002	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.001	.000	.003	.000	.001
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P11	Pearson Correlation	.086	.420**	.510**	.301**	.387**	.357**	.692**	.745**	.695**	.670**	1	.449**	.545**	.644**	.631**	.416**	.546**	.542**	.611**	.555**	.348**	.364**	.473**	.374**	.359**	.174
	Sig. (2-tailed)	.452	.000	.000	.007	.000	.001	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.000	.002	.001	.000	.001	.001	.126
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P12	Pearson Correlation	-.111	.208	.563**	.571**	.333**	.413**	.491**	.374**	.290**	.478**	.449**	1	.403**	.479**	.459**	.301**	.312**	.354**	.392**	.352**	.075	.117	-.036	.078	.112	.052
	Sig. (2-tailed)	.329	.066	.000	.000	.003	.000	.000	.001	.010	.000	.000		.000	.000	.000	.007	.005	.001	.000	.001	.511	.306	.753	.494	.325	.648
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P13	Pearson Correlation	-.235*	.367**	.482**	.363**	.609**	.504**	.578**	.500**	.489**	.562**	.545**	.403**	1	.626**	.541**	.501**	.571**	.618**	.542**	.574**	.249*	.309**	.313**	.360**	.381**	.207
	Sig. (2-tailed)	.037	.001	.000	.001	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.027	.006	.005	.001	.001	.067
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79

		P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12	P13	P14	P15	P16	P17	P18	P19	P20	P21	P22	P23	P24	P25	P26
P14	Pearson Correlation	-.055	.381*	.570**	.458**	.560**	.510**	.690**	.744**	.608**	.693**	.644**	.479**	.626**	1	.715**	.585**	.608**	.646**	.683**	.668**	.476**	.387	.364	.461	.475	.195
	Sig. (2-tailed)	.630	.001	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.000	.000	.000	.001	.000	.000	.086
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P15	Pearson Correlation	.099	.370**	.505**	.297**	.499**	.575**	.709**	.694**	.665**	.699**	.631**	.459**	.541**	.715**	1	.593**	.744**	.642**	.703**	.674**	.275*	.363**	.322**	.299**	.393**	.232*
	Sig. (2-tailed)	.385	.001	.000	.008	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.000	.000	.000	.000	.014	.001	.004	.008	.000	.040
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P16	Pearson Correlation	-.059	.287**	.357**	.295**	.458**	.434**	.554**	.559**	.488**	.480**	.416**	.301**	.501**	.585**	.593**	1	.667**	.604**	.558**	.576**	.314**	.181	.265*	.407**	.304**	.125
	Sig. (2-tailed)	.603	.010	.001	.008	.000	.000	.000	.000	.000	.000	.000	.007	.000	.000	.000		.000	.000	.000	.000	.005	.110	.018	.000	.007	.271
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P17	Pearson Correlation	-.064	.302**	.495**	.187	.516**	.439**	.647**	.641**	.601**	.609**	.546**	.312**	.571**	.608**	.744**	.667**	1	.642**	.599**	.615**	.307**	.393**	.356**	.425**	.509**	.207
	Sig. (2-tailed)	.576	.007	.000	.099	.000	.000	.000	.000	.000	.000	.000	.005	.000	.000	.000	.000		.000	.000	.000	.006	.000	.001	.000	.000	.067
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P18	Pearson Correlation	-.213	.348**	.379**	.176	.540**	.421**	.609**	.667**	.500**	.617**	.542**	.354**	.618**	.646**	.642**	.604**	.642**	1	.624**	.742**	.232*	.140	.263*	.330**	.270*	.173
	Sig. (2-tailed)	.060	.002	.001	.122	.000	.000	.000	.000	.000	.000	.000	.001	.000	.000	.000	.000	.000		.000	.000	.039	.220	.019	.003	.016	.127
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P19	Pearson Correlation	-.163	.411**	.420**	.295**	.513**	.444**	.625**	.590**	.673**	.600**	.611**	.392**	.542**	.683**	.703**	.558**	.599**	.624**	1	.743**	.299**	.266*	.373**	.400**	.336**	.170
	Sig. (2-tailed)	.151	.000	.000	.008	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000	.000		.000	.007	.018	.001	.000	.002	.134
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P20	Pearson Correlation	-.188	.380**	.435**	.217	.510**	.504**	.627**	.706**	.570**	.657**	.555**	.352**	.574**	.668**	.674**	.576**	.615**	.742**	.743**	1	.289**	.288*	.284*	.305**	.370**	.333**
	Sig. (2-tailed)	.098	.001	.000	.055	.000	.000	.000	.000	.000	.000	.000	.001	.000	.000	.000	.000	.000	.000	.000		.010	.010	.011	.006	.001	.003
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P21	Pearson Correlation	-.102	.227*	.266*	.059	.238*	.222*	.342**	.472**	.333**	.399**	.348**	.075	.249*	.476**	.275*	.314**	.307**	.232*	.299**	.289**	1	.435**	.333**	.566**	.393**	.163
	Sig. (2-tailed)	.370	.044	.018	.606	.034	.049	.002	.000	.003	.000	.002	.511	.027	.000	.014	.005	.006	.039	.007	.010		.000	.003	.000	.000	.151
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P22	Pearson Correlation	-.057	.234*	.296**	.116	.379**	.354**	.275*	.312**	.323**	.369**	.364**	.117	.309**	.387**	.363**	.181	.393**	.140	.266*	.288*	.435**	1	.412**	.412**	.504**	.132
	Sig. (2-tailed)	.620	.038	.008	.309	.001	.001	.014	.005	.004	.001	.001	.306	.006	.000	.001	.110	.000	.220	.018	.010	.000		.000	.000	.000	.246
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P23	Pearson Correlation	-.053	.228*	.282*	.089	.240*	.181	.492**	.423**	.512**	.425**	.473**	-.036	.313**	.364**	.322**	.265*	.356**	.263*	.373**	.284*	.333**	.412**	1	.374**	.405**	.187
	Sig. (2-tailed)	.644	.044	.012	.436	.033	.111	.000	.000	.000	.000	.000	.753	.005	.001	.004	.018	.001	.019	.001	.011	.003	.000		.001	.000	.099
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P24	Pearson Correlation	-.267*	.132	.186	-.080	.224*	.101	.321**	.356**	.325**	.335**	.374**	.078	.360**	.461**	.299**	.407**	.425**	.330**	.400**	.305**	.566**	.412**	.374**	1	.478**	.042
	Sig. (2-tailed)	.017	.245	.101	.482	.047	.377	.004	.001	.004	.003	.001	.494	.001	.000	.008	.000	.000	.003	.000	.006	.000	.000	.001		.000	.712
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P25	Pearson Correlation	.091	.159	.348**	.024	.263*	.268*	.425**	.334**	.476**	.439**	.359**	.112	.381**	.475**	.393**	.304**	.509**	.270*	.336**	.370**	.393**	.504**	.405**	.478**	1	.408**
	Sig. (2-tailed)	.427	.162	.002	.832	.019	.017	.000	.003	.000	.000	.001	.325	.001	.000	.000	.007	.000	.016	.002	.001	.000	.000	.000	.000		.000
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79
P26	Pearson Correlation	.150	.080	.133	.005	.160	.070	.297**	.254*	.257*	.360**	.174	.052	.207	.195	.232*	.125	.207	.173	.170	.333**	.163	.132	.187	.042	.408**	1
	Sig. (2-tailed)	.186	.481	.242	.966	.159	.541	.008	.024	.022	.001	.126	.648	.067	.086	.040	.271	.067	.127	.134	.003	.151	.246	.099	.712	.000	
	N	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79	79

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).