

Analysis of the Vulnerability of Public Procurement Management Processes in Morocco to the Risk of Corruption: An Approach based on the Analytic Hierarchy Process (AHP)

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Abstract

Today, the vulnerability of public procurement management processes to the risk of corruption, is considered as a crucial factor impacting the economic and social development of all countries as shown by studies conducted by several researchers and organizations. The aim of the present study is to address this issue taking into account the Moroccan context. This paper will review the different components of the public procurement management system, starting from the regulatory corpus to actors involved in the system. We then present the conceptual aspects related to the notion of corruption risk in the public procurement. We therefore propose an Analytic Hierarchy Process (AHP) method that take into account both independence and interdependence of assessment criteria in the Moroccan context by conducting interviews with all the actors involved in the procurement processes. Finally, we discuss the results of the empirical study which aims to identify sub-criteria that have the most impact upon the vulnerability to corruption risk of public procurement management processes.

Keywords: Public Procurement Vulnerability, Corruption Risk, Method of Analytic Hierarchy Process

1. Introduction

In an international context marked by openness, competitiveness and quest for performance, the economic growth and reputation of countries are increasingly dependent on the adoption of principles of good governance in public finance management.

In this regard, several international organizations, like the UN, the World Bank, the WTO and OECD, aims at fighting the problem of corruption considered as a threat to economic and human development. [1]

The United Nations Convention against Corruption (UNCAC), signed in December 2003 in Merida, Mexico, devotes a chapter Containing preventive measures to prevent and combat corruption more efficiently and effectively, indeed the article 9 of the convention establishes appropriate procurement as well as public finance management systems based on transparency, competition, and objective criteria;

This awareness has been driven by the high cost of corruption and its impacts that seriously undermine economic, social and human development and by extension the well-being and prosperity of people around the world. Indeed, a country with a per capita income of US\$2,000 that tackles corruption improves its governance and could in the long run see its income increase to US\$8,000. Globally, spending on public procurement accounts for an average of 13-20% of gross domestic product. [2]

Each year, the government spends an average of US\$9.5 trillion in public money through public procurement. [3]

Similarly, the European Commission has calculated that in the Member States, around 120 billion Euros (about 163 billion U.S. dollars) is lost each year due to corruption. It indicates that public procurement is particularly vulnerable to corruption. [4]

The total amount of public procurement, which corresponds to government activity to purchase goods, services and works, represented 12% of GDP and 29% of public expenditure in OECD countries in 2013, equivalent of about €4.2 billion. [5]

According to Organization for Economic Co-Operation and Development (OECD) estimates, money drained through corruption amounts to between 20 per cent and 25 per cent of the procurement budget, that is around US\$2 trillion annually [6]

The cost of corruption in public procurement is not only measured by money lost. Corruption distorts competition, can reduce the quality, sustainability and safety of public projects and purchases, and reduce the likelihood that the goods and services purchased really meet the public's needs. [7]

For example, Italian economists have found that the cost of several major public construction projects has fallen dramatically after the anti-corruption investigations of the early 1990s. The cost of building the Milan metro increased from \$227 million per kilometer in 1991 to \$97 million in 1995. The cost of a railway has fallen from \$54 million to \$26 million. [8]

Public procurement in Morocco presents a dual challenge: an economic issue (MAD 160 billion about 17% of gross domestic product) and an institutional issue linked in particular to the management of public funds. [9]

According to a World Bank estimate, the impact of corruption is equivalent to 5% of GDP, nearly MAD 39 billion.

Public procurement practices in Morocco, like other countries in the world, are characterized by the importance of economic and institutional issues, the multiplicity and diversity of actors involved in the process, as well as a tremendous number of legal texts governing regulating all phases of public procurement process.

All these factors make this process vulnerable to the risks of corruption, fraud, misuse of funds, poor execution, collusion, or in short, any misuse of power for private purposes such as personal enrichment or that of a third party or an entity.

Our study of the Moroccan case does not aim to assess the socio-economic impacts of this phenomenon of vulnerability of public procurement, but rather, we will explain the determinants of this vulnerability through the analysis of corruption risk. Thus, the study of this phenomenon of vulnerability of the different phases of the public procurement process to risks of corruption in the Moroccan context will be carried out through a qualitative approach and the implementation of the AHP method in the specific context of the Ministry of Economy and Finance.

This study aims, thus, (i) to enrich the state of the art on the risk of corruption in public procurement, (ii) to shed light on areas of vulnerability and implications for different actors (public authorities, NGOs, citizens ...) and (iii) to contribute to a better understanding of these areas.

2. Public Procurement in Morocco: Principles and Issues

Tackling public procurement in Morocco leads us to present the evolution of the regulatory framework, stakeholders and economic, social and environmental issues.

2.1. Regulatory Framework

The issue of public procurement management is a very long-standing problem, which has been the subject of particular attention at every important stage of modernization of the Moroccan State. The institution during the reign of Moulay Slimane (1792-1822), of the body of the Oumana, (public accountants), constitutes the first financial organization in this field.

It was not until the beginning of the Protectorate, that the general rules of public accounting were enacted in their modern form, with the enactment of the Dahir of 9 June 1917 establishing the public accounting regulation.

Many reforms and complements were made to this text, immediately after the independence of Morocco (1956) and until the mid-1970s, to accompany the evolution of public order, in volume and composition. The legislation has thus taken into account public policies, such as the policy of dams. [10]

It is necessary to go back to 1965 to find the origins of the regulatory corpus governing public procurement through the Royal Decree No. 2-65-116 of 19 May 1965 approving the General Conditions of Contract applicable to works contracts carried out for the account of the Ministry of Public Works and Communications, the implementation of which will be extended to the public administrations of the State by another Royal Decree, that of 18 June 1966.

The year 1976 will see the enactment of the Decree No. 2-76-479 relating to public works, supplies and services contracts awarded on behalf of the State.

To overcome the various shortcomings of the 1976 Decree and also under pressure from international donors and the Moroccan private sector, the Decree of 30 December 1998 setting out the conditions and forms of State procurement procedure was promulgated.

By extension, the following Decrees will be enacted: The Decree No. 2-99-1087 of 04 May 2000 approving the General Conditions of Contract applicable to contracts of work awarded on behalf of the State, and the Decree No. 2-01-2332 of 4 June 2002 approving the General Conditions of Contract applicable to services contracts.

The reforms of 1998 and 2007 were established respectively by the Decree of December 30, 1998 and by the Decree of February 5, 2007, these reforms formed the legal and regulatory basis for setting the conditions and forms by which all administrations must carry out their contracts. [11]

The last Decree on public procurement dated on 20 March 2013 came into force in a particular context marked by the willingness of public authorities to:

- Implement the principles of the 2011 Constitution;
- Address the inadequacies of 2007 regulations;
- Meet the expectations of public purchasers and those of citizens;
- Consider recommendations and proposals of international financial organizations.

In order to maintain a balance between the interests of different stakeholders in the public procurement process, the new Decree enshrines the following principles:

- Upholding of the principles of competition, transparency and efficiency in the preparation of public procurement, their allocation and monitoring of their achievement through the implementation of provisions aimed, on the one hand, at ensuring fairness

and healthy competition between companies, and on the other hand strengthening the rules of ethics within the administration;

- Ensuring free competition in awarding contracts by ensuring equal access to public procurement for bidders, and by establishing open bidding as a general rule of procedure;
- Encouraging performance in the preparation of the tender, evaluation of applications and award of contracts by strengthening the instruments that enable procurement purchasers to achieve better results in implementing their procurement;
- Enhancing guarantees provided to competitors by adopting provisions safeguarding the interests of companies;
- Strengthening ethics and integrity in the public procurement management through the implementation of procedures and controls that can lead stakeholders in the procurement process to make good use of the rules governing this procurement;
- Unifying and simplifying procedures and rules governing the public procurement management by clarifying the procedures and facilitating their application by all stakeholders.
- Upgrading rules and procedures of public procurement to cope with international norms and standards

In addition other texts govern the enforcement of public expenditure, namely, Law No. 61-99 on the responsibility of authorizing officers, auditors and accountants, Law 69-00 relating to the financial control of the State over State-owned enterprises and other bodies, the Decree of public accounting, as well as Decrees approving the General Conditions of Contract applicable to services and works contracts.[11]

2.2. Public Procurement Actors

The public procurement management processes involve several stakeholders: internal and external actors.

For internal actors, the main actor is the authorizing department which is primarily responsible of the entire public expenditure process. The second actor is the contracting authority who launches the contract and implements it on behalf of the authorizing officer. There are also the technical department, the purchaser department, and the public procurement department that make the insertions and prepare the summonses of commissions.

There are also tenders committees and their technical commissions. The budget and accounting department responsible for all accounting commitment, liquidation, scheduling and consolidation/deferral. In addition to these actors, there are also monitoring committees or steering committees that are provided by the special prescriptions book. All of these stakeholders are involved in the delivery of the works.

For its part, the archiving department is considered an actor because all the procurement documents must be archived. Dashboard monitoring entities, management control but also internal audit entities carry out risk management and internal control assessment and also human resources training services.

For external actors, there are bidders, then awardees and contract holders, financial control entities of the expenditure from the public accountant or the State comptroller and/or paying treasurer to the control entities in hindsight.

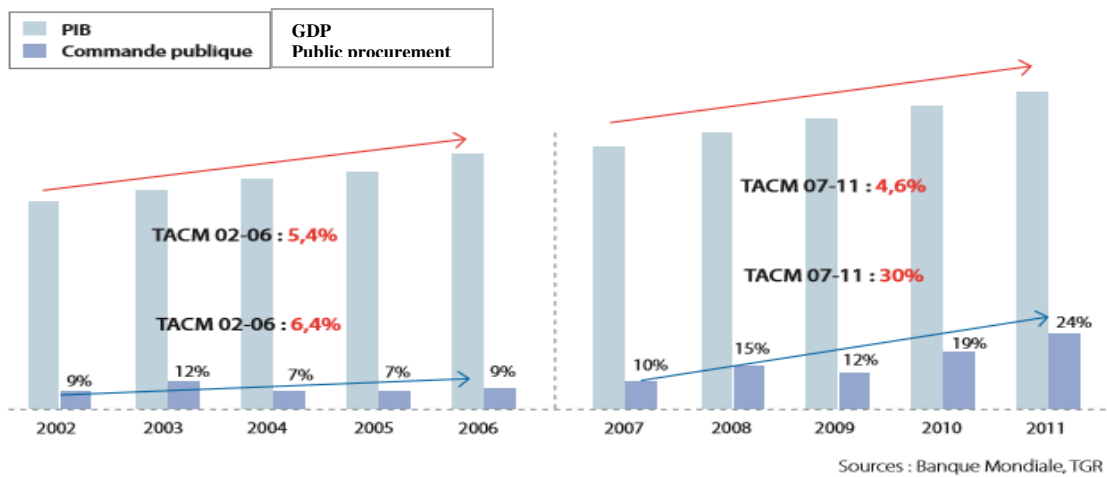
There are also advertising entities (Portal Administration, Ad Logs) and Monitoring Entities of Technical Control (Project Management, Technical Design Offices, Control and Testing Laboratories).

Other actors such as funders, the National Commission for Public Procurement and other partners such as local authorities and associations are also involved. [12]

2.3. Economic, Social and Environmental Issues

The stakes of public procurement are no longer to be demonstrated. As noted above at the international level, Morocco is no exception. The data show the following findings:

- The economic weight of public order between 18% and 20% of Moroccan GDP or nearly MAD 150 billion. (On average, the State carries out 11,000 contracts annually, more than 91% of which are per open bidding);
- The growth of public order was much stronger, about 30% against a GDP that grew by 4.6% (over the period from 2007 to 2011);
- Inequality between sectors (telecoms has increased more than 10-fold);
- The construction or engineering sectors are more than 75% dependent on it in turnover;
- 54% of professionals consider the procedures to be complex and costly;
- 60% of companies surveyed felt that public procurement was not systematically transparent.[9]



AAGR 02-06: 5.4%

AAGR 02-06: 6.4%

Average annual growth rate (AAGR)

Sources: General Treasury of the Kingdom of Morocco

AAGR 02-06: 4.6%

AAGR 02-06: 30%

In addition, reports produced by various national and international institutions highlight the persistence of problems of complex and non-transparent procedures, particularly in public procurement.

In this sense, a survey carried out on behalf of the Transparency Maroc Association, among a sample of 400 companies, reveals that only 10% of them regularly participate in public procurement and almost 60% consider that the procedures are complex, costly and stained by corruption.

In these circumstances, and despite the important issues it represents, public procurement does not optimally contribute to the development of national economy. In particular, it does not sufficiently participate in the emergence of high-performing enterprises, particularly among small and medium-sized enterprises (SMEs). [10]

3. Corruption Risk in Public Procurement

The examination of corruption risk leads us to review the main definitions and its management method.

3.1. Definitions of Corruption in Public Procurement

As Rousseau stated in the 18th century, the legitimacy of national public power emanates from the people. The government carries out the sovereign's instructions; its power comes from the trust of the people. When the use of public power departs from its purpose, through abuse, problems of corruption emerge. This is in line with the definition of corruption as "the abuse of public functions for private purposes". This definition is also the most used by researchers on the concept of corruption. [8]

Presently, academia has not yet given a unified definition of "corruption". It is generally defined as the corruption of public officials in State bodies that use the power of corruption, bribery, extortion, fraud and other acts. There are many ways to define corruption in detail. But no definition can be applied to all research objectives. [13]

Therefore, the diversity of the corruption contents must first be recognized. Based on the research intent, the appropriate concept of corruption and the measurement methods chosen. [14]

In the case of public procurement, they refer to the acquisition by a government department or a public institution of goods or services, ranging from bed sheets for hospitals and textbooks for schools to financial and legal services, as well as the commissioning of large-scale construction and infrastructure works, such as roads, bridges and airports.

Public procurement refers to all stages of the procurement process, covering the initial needs assessment, budget allocations and initial market research until the preparation of bidding documents, bid evaluation and awarding of contracts. The implementation and administration of the contract (including the common practice of contracts change) as well as auditing and monitoring are also taken into account in the public procurement process. [7]

Public procurement is the method of purchase allowing a company to buy in the best financing terms, to face several offers in order to be able to ensure the best quality-price ratio and the best time and conditions of delivery. Although public procurement is subject to a legal-institutional framework, it has become the preferred playground for much-maligned practices around the world such as fraud, corruption and clientelism that have become the commonplace to win a public procurement. [15]

Corruption in public procurement is a global phenomenon that affects countries at all stages of development and has extremely negative effects on the proper management of public funds and can also pose a danger to the health and safety of users. Public procurement is particularly vulnerable to corruption due to financial issues, to the multiplicity of national and sometimes international actors and to the limitations of internal and external regulations and control procedures. [16]

Corruption can be initiated by the private sector (directly or through agents and intermediaries) – on the supply side – or by a government official – on the demand side. The most obvious form of corruption associated with public procurement is the bribery of public officials to obtain a favorable contractual decision in the absence of a right or claim. More subtle forms of corruption occur when bribes are used to manipulate budget allocations and project selection, even before the contractual process begins, manipulating eligibility criteria or with biased technical specifications. Bribes can take the form of gifts, money, favors, jobs for family members and donations to political parties or charities. [7]

3.2. Management of Corruption Risk

Integrity risks arise at every stage of the procurement process, from the needs assessment and submission phase to contract execution and payment. The nature of the risk to integrity may vary from stage to stage and warning signals include undue influence, conflicts of interest and various types of

fraud risks. The graph below provides a summary of the risks to integrity in the procurement process. [11]

Pre-Tendering Phase	Needs assessment and market analysis	<ul style="list-style-type: none"> • Lack of adequate needs assessment • Influence of external actors on officials decision • Informal agreement on contract
	Planning and budgeting	<ul style="list-style-type: none"> • Poor procurement planning • Public procurement not aligned with overall investment decision-making process • Failure to budget realistically or deficiency in the budget
	Development of specifications/requirements	<ul style="list-style-type: none"> • Technical specifications are tailored to a specific company • selection criteria is not objectively defined and is not established in advance • Requesting unnecessary samples of goods and services • Buying information on the project specifications
	Choice of procurement procedure	<ul style="list-style-type: none"> • Lack of proper justification for the use of non-competitive procedures • Abuse of non-competitive procedures on the basis of legal exceptions: contract splitting, abuse of extreme urgency, non-supported modifications
Tendering phase	Request for proposal/bid	<ul style="list-style-type: none"> • Absence of public notice for the invitation to bid • Evaluation and award criteria are not announced • Procurement information isn't disclosed and isn't made public
	Bid Submission	Lack of competition or cases of collusive bidding (cover bidding, bid suppression, bid rotation, market allocation)
	Bid evaluation	<ul style="list-style-type: none"> • Conflict of interest and corruption in the evaluation process through: <ul style="list-style-type: none"> ○ Familiarity with bidders over time ○ Personal interests such as gifts or future/additional employment ○ No effective implementation of the "four eyes-principle"
	Contract award	<ul style="list-style-type: none"> • Vendors fail to disclose accurate cost or pricing data in their price proposals, resulting in an increased contract price (i.e. invoice mark-ups, channel stuffing) • Conflict of interest and corruption in the approval process (i.e. no effective separation of financial, contractual and project authorities) • Lack of access to records on the procedure
Post-award Phase	Contract Management/performance	<ul style="list-style-type: none"> • Abuses of the supplier in performing the contract, in particular in relation to its quality, price and timing: <ul style="list-style-type: none"> ○ Substantial change in contract conditions to allow more time and/or higher prices for the bidder ○ Product substitution or sub-standard work or service not meeting contract specifications ○ Theft of new assets before delivery to end-user or before being recorded ○ Deficient supervision from public officials and/or collusion between contractors and supervising officials ○ Subcontractors and partners chosen in an on-transparent way or not kept accountable
	Order and payment	<ul style="list-style-type: none"> • Deficient separation of financial duties and/or lack of supervision of public officials leading to: <ul style="list-style-type: none"> ○ False accounting and cost misallocation or cost migration between contracts ○ Late payments of invoices • False or duplicate invoicing for good and services not supplied and for interim payment in advance entitlement

Source: OECD (2016) Preventing corruption in public procurement

Corruption in all its forms can occur at every stage of the procurement process described above, regardless of the sector or scale. Corruption in the form of everyday abuse of entrusted power by low and mid-level public officials occurs in the context of smaller purchases, such as purchasing office equipment or textbooks or in local service delivery such as schools' admissions and hospitals.

In contrast, acts of corruption committed at a high level of government, which distort social or economic policies or the central functioning of the State, can occur in public works projects, the supply of large quantities and privatization projects. Political corruption also occurs when policies, institutions and rules of procedure in the allocation of resources are manipulated during the needs assessment and budget planning phases, for example.

Purchasing processes are vulnerable to collusion, i.e. "secret agreements between parties of the public and/or private sector to commit actions aimed to deceive or commit fraud for the purpose of making illicit financial gains". Bidders may resort to arrangements to obstruct competition by deceiving or depriving others of their rights in order to obtain an unfair advantage. Collusion between bidders can manipulate the award decision and may be a particular problem in smaller public procurement where there are fewer competitors.

Public procurement procedures are often complex and, in many countries, the transparency of the process is extremely limited and the manipulation is difficult to detect. Moreover, few people who become aware of the corrupted activity will report it. [7]

Corruption-related risk management must take into account different situations that bring out different reflections of the corruption risk depending on the procedures, types of contracts, size and complexity of the sector and the degree of objectivity.

Public procurement is often supposed to be carried out in accordance with the principles of the call for international competition. The main steps in this procedure are: (1) the choice and definition of need; (2) the design of the competitive bidding file, including the technical specifications and assessment criteria; (3) qualification and identification of bidders, including pre-qualification and shortlist; (4) bid assessment; (5) award of contract; (6) negotiations, final agreement; (7) implementation/delivery; (8) monitoring and controls.

Each step is described by the rules developed in the procurement guidelines, ensuring fair competition and best quality/price ratio. However, non-compliance with the rules is a problem in many countries. The ordinary procedure can be totally neglected, based solely on negotiations. Alternatively, one or more steps can be ignored, leaving uncertainty as to how competition and transparency have been protected. There are several legitimate reasons for evading the rules.

The type of contract may vary. The most frequently mentioned contracts are "fixed-price contracts", the price of which is predetermined. Contracting rules may not apply to all sectors of an economy. Public procurement involving national defense or national security is often excluded from ordinary procurement rules.

It is important to note, however, that choosing the contract between a government and a company can be very important to induce economic behavior and reduce the possibility of corruption when executing the project/delivery of assets.

The size and complexity of the project or product in question are the most important factors explaining the differences in motivation and the potential for large-scale corruption. Moody-Stuart describes three attractiveness criteria:

- (i) Market size: Bribes are often calculated as a percentage of the total sum, representing a proportional relationship. Therefore, the more money there is the more reasons to ask for a bribe.
- (ii) Mystification: The higher the number of technologies involved, or it seems, the more attractive the project will be to potential beneficiaries. This type of "mystification" reduces the risk of being criticized for paying too much. Moody-Stuart illustrates: "How

many people can say whether a particular fighter aircraft should cost \$21 million instead of \$23 million?")

- (iii) Immediacy: the mandate can be brief for many politicians but also for civil servants. As a result, the most attractive projects are those in which the total purchase price, or at least a very large deposit, is payable at an early stage.

According to Rose-Ackerman, "*Whenever regulators have discretion, there is an incentive to bribe.*" This discretion of public officials often represents a golden opportunity to obtain bribes. This way of classifying public procurement to varying degrees of discretion or objectivity is important in understanding the tendency to corruption in different situations.

In short, here are some important elements to understand the corruption risk in public procurement: the market value, the complexity of technology, the urgency to acquire the assets or the immediacy of the project, as well as the discretionary power of public servants. [17]

Another register complementary to risk management approaches includes internal audit, which can lead, when exercised professionally, to reduce fraudulent procurement practices. Internal auditing of public procurement is of crucial importance for a better rationalization of the State's funds, which, like any resource, is by nature scarce. It cannot therefore be accepted that, at a time when these funds could be used for the application of the economic and social policy of the State, for the creation of basic infrastructure in the interest of the people, the public funds are diverted by indelicate civil servants.

Mismanagement and corruption mean that when contracting contracts, especially works, huge sums of money are often wasted, which has negative effects on the State's budget. Errors and inaccuracies in relation to public procurement can have very costly consequences at any stage where they occur.

- At the time of preparation;
- During the conclusion of the contract;
- During the implementation of the works (especially when the plans are changed);
- During the control of technical monitoring activities;
- When it is necessary to expand the contract (endorsements);
- In case of defects in the implementation or carrying out not in accordance with the contract.

As a supervisory body, the internal auditor must go beyond the simple search for conformity to the texts. The discovery and reporting of corruption reports, the search for causes that have led to poor planning, to waste and mismanagement are concerns that must be present in the auditor throughout the mission that must also have a preventative effect. As a result, internal auditing of government public procurement must become a consistent activity that must be seen as a tool for improving performance. Better use of public funds is in the interest of all players involved in public procurement, buyers as suppliers, the former optimize their quality-price ratio and the latter benefit from a transparent procedure and the possibility of participating in future public procurement. [15]

4. Proposed Method

For the analysis of the vulnerability of public procurement processes to corruption risk, we have opted for multi-criteria decision-making methods which allow us to assess vulnerability through the use of several assessment criteria.

In this regard, there are several multi-criteria methods, among them; we have chosen the Analytic Hierarchy Process (AHP) for its characteristics that allow the consideration of both the independence and interdependence of the assessment criteria.

4.1. Features of the AHP

The AHP method is a structured technique for organizing and analyzing complex decision developed by the mathematician Thomas Lorie Saaty is part of the family of multi-criteria methods of Multi-Criteria Decision-Making (MCDM); it represents a powerful and flexible method of decision support applied for simple or complex problems in many situations.

One of the main advantages of the AHP method is its simplicity compared to other decision-making methods. Also, one of these strengths is its ability to deal with quantitative and qualitative criteria, in the same problem. [18]

It also offers the possibility of establishing a hierarchical structure of criteria, which allows the decision maker to define specific criteria and sub-criteria facilitating the phase of defining degrees of preference. [19]

The AHP method breaks down the multi-criteria decision problem into a hierarchy system, descending into the hierarchy from large to small elements. This method, which is based on a division of the decision-making process into a hierarchical structure, is characterized by determining the weights of criteria and alternatives and the use of pair-wise comparisons between an element and its higher level of hierarchy. Once the hierarchy is built, the various criteria are compared to each other two at a time, with respect to their impact on an element above them in the hierarchy and the overall objective of the study which will generate a vector of priority of these criteria. [20]

The application of AHP to complex decision have produced extensive results in a variety of areas, such as: risk management, quality management, operations management.

4.2. Implementation of the AHP

The fundamental steps in the implementation of the AHP method [21] consist first of all in the construction of a hierarchical analysis of the subject to be assessed by identifying the criteria and alternatives. The main steps in this method are:

4.2.1. Elaboration of the Criteria Comparison Table

In this step the comparisons between two criteria will be made to assess the importance of each of them. In this context, Saaty [22] proposes a 5-level assessment based on the following table:

Interpretation	Numerical rating
The two elements are of equally importance	1
The online element is a slightly more important than the column element	3
The online element is more important than the column element	5
The online element is strongly more important than the column item	7
The online element is absolutely more important than the column element	9
The online element is a slightly less important than the column element	1/3
The online element is less important than the column element	1/5
The online element is strongly less important than the column element	1/7
The online element is absolutely less important than the column element	1/9

Assessment levels of SAATY

Construction of the Comparison Matrix

Using pairwise comparison, the relative importance of one criterion over another can be expressed by transcribing the values of the assessment predicted in the table above.

$$A = \begin{pmatrix} w_1/w_1 & w_1/w_2 & \dots & \dots & w_1/w_p \\ w_2/w_1 & w_2/w_2 & \dots & \dots & \dots \\ \dots & \dots & \ddots & \dots & \dots \\ \dots & \dots & \dots & \ddots & \dots \\ w_p/w_1 & \dots & \dots & \dots & w_p/w_p \end{pmatrix} = \begin{pmatrix} 1 & w_1/w_2 & \dots & \dots & w_1/w_p \\ w_2/w_1 & 1 & \dots & \dots & \dots \\ \dots & \dots & \ddots & \dots & \dots \\ \dots & \dots & \dots & \ddots & \dots \\ w_p/w_1 & \dots & \dots & \dots & 1 \end{pmatrix}$$

Calculating Priority Vectors

The contribution of each criterion to the organizational goal is determined by calculations made using priority vectors. These vectors are calculated from the comparison judgment matrix by first making the sums of each column and then dividing each element of the matrix by the total of the column. Next, the average of the elements of each line of the matrix is calculated.

By putting $c_{jm} = w_j/w_m \forall j, m = 1, \dots, p$, we find

$$A = \begin{pmatrix} 1 & c_{12} & \dots & \dots & c_{1p} \\ c_{21} & 1 & \dots & \dots & \dots \\ \dots & \dots & \ddots & \dots & \dots \\ \dots & \dots & \dots & \ddots & \dots \\ c_{p1} & \dots & \dots & \dots & 1 \end{pmatrix} = (c_{jm})_{1 \leq j, m \leq p} \text{ with } c_{jm} = 1/c_{mj} \forall j, m$$

$$S_m = \sum_{j=1}^p c_{jm} \quad \forall m = 1, \dots, p \quad t_{jm} = c_{jm}/S_m \quad \forall j, m = 1, \dots, p$$

$$\tilde{P}_j = \sum_{m=1}^p t_{jm}; P_j = \frac{1}{p} * \tilde{P}_j$$

The most important criteria XM has as a priority

$$P_M = \frac{1}{p} \sum_{m=1}^r t_{Mm} = \text{Max}_{j=1..}$$

4.2.4 Calculating the Maximum Eigenvalue λ_{max}

The maximum eigenvalue λ_{max} is calculated by multiplying the comparison matrix and the vector of priorities.

4.2.5 Calculating the Consistency Ratio (CR)

The Consistency Ratio (CR) compares actual reliability with theoretical reliability. The closer this ratio is to 0, the more consistent the assessment. For Saaty the matrix will be considered consistent if the resulting ratio is less than 10%. Otherwise, the assessment of appraisal may require some revisions.

The CR in the following form:

$$\boxed{\text{CR} = \text{CI} / \text{RI}}$$

With:

- **RI, Random Index developed by Saaty:** It indicates the level of reliability of the same assessment carried out several times.
- **CI, Consistency Index:** it represents the level of reliability of judgment.

Calculating RI

In order to calculate the Random Index (RI), Saaty proposes a scale to make random judgments for a high number of replication [20] and [21]. This index represents the average of the indices calculated at each replication for different square matrix size (N).

The IR values proposed by Saaty are presented in the following table:

N	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
RI	0	0	0.58	0.9	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

Saaty Random Scale

CI Calculation

The calculation of the consistency index is given by the following formula:

$$CI = (\lambda_{max} - n) / (n - 1)$$

λ_{max} : maximum eigenvalue.

n : number of evaluated criteria

Calculating the Scores of Alternatives

The calculation of the scores of each alternative according to the AHP method [21] and [22] is done by adopting the following approach:

- I. **Elaboration of the alternative comparison matrix:** It is a question of comparing, for each criterion, the alternatives between them in pairs and building a comparison matrix.
- II. **Establishing the matrix of complete comparisons of alternatives:** In this step, the sums of each column of the comparison judgment matrix will be calculated and each element of the matrix will be divided by the total of the column. The calculation of the average elements of each line of the matrix allows the calculation of a priority vector for each criterion. These vectors allow us to build the matrix of complete comparisons of alternatives.
- III. **Determining the relative comparison matrix of each alternative:** Multiplying the complete comparison matrix and priority vector allows the score of each alternative to be calculated using the AHP method. This determines the performance of each alternative.

4.3. A Qualitative Approach to Assessing the Criteria

To understand the qualitative aspects of assessing the criteria, it is necessary to choose a methodology to carry out the analysis.

Indeed, the methodology establishes how we will analyze, discuss and decipher a phenomenon.

A case can be a person or group of people, a specific project, an organization or group of organizations, or even an industry. In management science, the last three categories are the most widely used. [23]

Based on the study case as a research methodology, that investigates a phenomenon within its real life context we will attempt, from the exploration of the case of public procurement management processes, to bring out subjective elements to assess vulnerability to corruption risk.

This method consists of conducting a field observation by making site visits to understand the mechanisms of operation, to identify the actors and to determine the risk management system and its impacts. To complete this observational process, it was necessary to conduct a series of individual interviews through an interview guide.

The investigative tool chosen, in the context of field exploration, is semi-directive interview. This type of interview, also known as semi-structured interview, allows us to address the themes generally drawn from the non-directive interviews of which they are an extension. The interview is structured in the form of a grid of themes and sub-themes formulated in open questions, which lead to comments.

The choice of this tool was motivated by the following considerations:

- A single questionnaire cannot be adapted to a heterogeneous target.
- The interviewer work at the same field, which has facilitated direct contact.

- Interviews highlight important elements for diagnosis such as motivations, implications, and perceptions of interviewees, which are difficult to explain by other methods of investigation.

Moreover, the choice of such tool was also reinforced by the limited number of the target population of the investigation. This is a target population of 30 resource people involved throughout the process. This choice is justified, moreover, by the fact that through interviews with these resource people, we will be able to address the problem of corruption risk at the level of all phases of public procurement from the conception/preparation to the implementation/control in upstream and downstream. This range of resource people also includes representatives of companies/providers/suppliers and the national public procurement commission. These are the following resource people:

- Top management (5): authorizing officers at the administrative and general affairs directorate (AGAD) and at the Ministry;
- Purchasing, Expenditure and Accounting services (9): contracting authority and expenditure scheduling at AGAD and at the Ministry;
- Heads of the risk management steering system (2): responsible for risk management, internal control at AGAD;
- Heads of Upstream Control (6): responsible for the Budget Directorate, the Directorate of Public Enterprises and Privatization and the General Treasury of the Kingdom;
- Downstream/External Control Managers (2): inspections and Court of Auditors;
- Business/provider/supplier representatives (5): intervening in three sectors (works, information systems and studies);
- Directors at the National Commission of Public procurement (1): representative of the Ministry of Economy and Finance.

The interview guide is divided into four main phases, with the definition for each phase of the objective, the instructions and the sub-themes that will be discussed. Since the selected topics will be addressed in a variable way, depending on the position of the interviewee and its importance in relation to the risk management system.

The interview guide gives each phase-themed couple a weight on a scale of 1 to 5 indicating the importance of the theme in relation to the interviewee. A scoring system to assess criteria related to vulnerability to corruption risk allows positioning each phase of the public procurement management process in relation to the other and the sub-criteria impacting the vulnerability between them and for each phase (% alternatives).

5. Empirical Study and Results

The results and analysis of the data from the empirical study will be presented in this section.

5.1. Baseline Data

Through the interviews conducted with all stakeholders and drawing on examples of the division of the public procurement management process that emerge from the literature review (Corruption in Public Procurement, a Practical Guide: Page 7, key steps to the public procurement process), we propose, as part of this work, to retain five phases that should allow us to cover critical activities related to corruption.

Table 1: Phases of public procurement process

Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Specification of needs and Preparation of bidding documents	Works of tenders committee	Accounting commitment	Implementation/Reception/ Service rendered	Authorization and payment

With regard to the selection of sub-criteria impacting vulnerability to corruption risk, it should be noted that, based on the studies carried out for the implementation of internal control systems, in particular at the AGAD of the Ministry of Economy and Finance, 6 criteria should be identified [24] :

1. Formalization of procedures & traceability;
2. Organization (Orga.) and separation of tasks;
3. Information system (IS);
4. Human resources (HR) and management capabilities;
5. Legal framework (Legal) and documentation;
6. Reporting, communication and awareness raising

In addition, the COSO frame of reference (Committee of Sponsoring Organizations of the Treadway Commission) indicates in its second version (COSO II) that there is a direct link between the objectives that the entity seeks to achieve, the components of internal control necessary for their implementation and the organizational structure of the entity (its business units, legal entities, etc.). This link is represented in the form of a cube:

- The three categories of objectives – related to operations, reporting and compliance - are represented by the columns;
- The five components of internal control are represented by the horizontal lines of the front of the cube;
- The entity's organizational structure is part of the third dimension of the cube. [25]

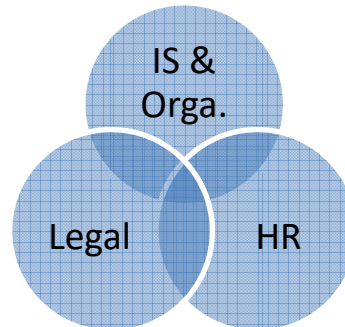


The identification and inventory of sub-criteria have been enriched and adjusted (grouping, deletion, simplification.) through interviews conducted and the exploration of literature in connection with the frame of reference COSO II.

Indeed, it appears from the exchanges with the interviewees that sub-criteria 1, 2 and 3 have great similarities in terms of the structuring effect on management practices and the impact on the control of these practices by formalizing procedures, automating tasks and ensuring the separation of incompatible tasks. Similarly, sub-criteria 4 and 6 were grouped into the point that the Human element remains the factor determining aspects of training, management, communication and awareness. The legal sub-criteria relate to the guidance of procurement management processes by legislation and

regulations stipulating the principles and rules to be observed throughout the implementation phases of public procurement. It must be handled in a separate area with regard of its specificities.

Also, and based on the elements described above, and for the purposes of our study, it was proposed to retain 3 main sub-criteria impacting vulnerability to risk corruption and which are thus interdependent: the organization and information system, legal framework and human resources.



5.2. Decision of Criteria Matrix

To make a pair-wise comparison of criteria/phases between them (always from the perspective of vulnerability to corruption risk), it was based on the responses provided by the various officials interviewed in using a scoring system and Saaty's proposed 5-level assessment. The results obtained are as follows:

Table 2: comparison of criteria

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Phase 1	1	5	7	3	5
Phase 2	1/5	1	3	1/3	1
Phase 3	1/7	1/3	1	1/5	1/3
Phase 4	1/3	3	5	1	3
Phase 5	1/5	1	3	1/3	1

5.3. Matrix of Decision Criteria in Relative Percentages

In this step, the sums of each column of the comparison matrix will be calculated and each element of the matrix divided by the total of the column. The calculation of the average elements of each line of the matrix allows the calculation of a priority vector for each criterion. These vectors allow us to build the matrix of comparisons of alternatives during the last stage.

Table 3: decision criteria in relative percentages

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5	Average
Phase 1	0.533	0.484	0.368	0.616	0.484	0.497
Phase 2	0.107	0.097	0.158	0.068	0.097	0.105
Phase 3	0.076	0.032	0.053	0.041	0.032	0.047
Phase 4	0.178	0.290	0.263	0.205	0.290	0.245
Phase 5	0.107	0.097	0.158	0.068	0.097	0.105

The first observations that can already be drawn from this table are the importance of two key and interdependent phases in the approaches to managing corruption risk in public procurement, namely: Phase 4, Implementation/Reception/Service rendered and Phase 1, Needs/Specification/Preparation of bidding documents. Because, in fact, the initial decision is crucial in the entire public procurement process and if the needs are tailored to a specific company, poorly defined or are the

subjects of collusion between stakeholders, this certainly results in discretionary margins at the time of the implementation, reception and certification of the service rendered.

5.4. Calculating the Consistency Index

The maximum eigenvalue is calculated by multiplying the comparison matrix and the vector of priorities.

$$\begin{matrix}
 & \text{Matrix of decision criteria} & & \text{Vector of averages \% relative (Vi)} \\
 \left[\begin{array}{ccccc}
 1 & 5 & 7 & 3 & 5 \\
 1/5 & 1 & 3 & 1/3 & 1 \\
 1/7 & 1/3 & 1 & 1/5 & 1/3 \\
 1/3 & 3 & 5 & 1 & 3 \\
 1/5 & 1 & 3 & 1/3 & 1
 \end{array} \right] & \times & \left[\begin{array}{c}
 0.497 \\
 0.105 \\
 0.047 \\
 0.245 \\
 0.105
 \end{array} \right]
 \end{matrix}$$

0.497119254	0.526535259	0.328140023	0.73616849	0.52653526	t1= Sum line 1=2.61449828
0.099423851	0.105307052	0.140631438	0.0817965	0.10530705	t2= Sum line 2=0.53246589
0.071017036	0.035102351	0.046877146	0.0490779	0.03510235	t3= Sum line 3=0.23717678
0.165706418	0.315921156	0.23438573	0.2453895	0.31592116	t4= Sum line 4=1.27732396
0.099423851	0.105307052	0.140631438	0.0817965	0.10530705	t5= Sum line 5=0.53246589

t1/v1	5.259297976
t2/v2	5.056317521
t3/v3	5.059539727
t4/v4	5.205291889
t5/v5	5.056317521
Total	25.63676464

The calculation of the maximum eigenvalue **Lamda Max** and the **Consistency Index** are therefore obtained as follows:

Lamda Max	= 25.63676464/5	5.127352927
CI	= $(\lambda_{max} - 5) / (5 - 1)$	0.031838232
Random Index (RI)	Ech SAATY N=5	1.12

The value of the Consistency Ratio is: **CR - CI / RI - 0.028426993**

The value of CR (2.842%) is less than 10%.

Thus, the matrix is considered sufficiently consistent.

5.5. Matrix of Decision Sub-Criteria in Relative Percentages by Phase

By adopting the same logic and starting from qualitative study and interview guides, we can establish for each phase the vulnerability in relation to the three sub-criteria.

Table 4: sub-criteria of decision for Phase 1

Phase 1 : Specification of needs and Preparation of bidding documents				
	IS and Orga.	Legal	HR	
IS and Orga.	1	1/3	1/5	
Legal	3	1	1/5	
HR	5	5	1	
Total	9	61/3	12/5	
With % relative				
	IS and Orga.	Legal	HR	Average
IS and Orga.	0.111	0.053	0.143	0.102
Legal	0.333	0.158	0.143	0.211
HR	0.556	0.789	0.714	0.686

By way of comment, one could say that the Human Resources (HR) sub-criterion presents the maximum vulnerability to corruption risk at the first phase of the definition of specifications and needs and the preparation of bidding documents. This is followed by the legal sub-criterion as this phase is weakly impacted by the problems of the information system and organization.

Table 5: sub-criteria of decision for Phase 2

Phase 2: Works of tenders committee				
	IS and Orga.	Legal	HR	
IS and Orga.	1	1/5	1/5	
Legal	5	1	1/3	
HR	5	3	1	
Total	11	41/5	11/2	
With % relative				
	IS and Orga.	Legal	HR	Average
IS and Orga.	0.091	0.048	0.130	0.090
Legal	0.455	0.238	0.217	0.303
HR	0.455	0.714	0.652	0.607

The second phase on the works of the tenders committee has the same results as the first with the predominance of the HR and legal sub-criteria, with, however, a greater relative importance of the legal sub-criterion taking into account the very precise framework of the works of the commissions by the regulatory texts.

Table 6: sub-criteria of decision for Phase 3

Phase 3 : Accounting commitment				
	IS and Orga.	Legal	HR	
IS and Orga.	1	5	5	
Legal	1/5	1	1/3	
HR	1/5	3	1	
Total	1 2/5	9	6 1/3	
With % relative				
	IS and Orga	Legal	HR	Average
IS and Orga.	0.714	0.556	0.789	0.686
Legal	0.143	0.111	0.053	0.102
HR	0.143	0.333	0.158	0.211

At the Phase 3 level, the role of information and organizational systems is determined as they allow for better control of accounting commitment in terms of credit availability data and budget allocations and thus avoid, as a result, greater discretion for stakeholders. Hence, this sub-criterion is highly vulnerable to the corruption risk at the level of this third phase.

Table 7: sub-criteria of decision for Phase 4

Phase 4 : Implementation/Reception/ Service Rendered				
	IS and Orga.	Legal	HR	
IS and Orga.	1	1/5	1/5	
Legal	5	1	1/3	
HR	5	3	1	
Total	11	41/5	11/2	
With % relative				
	IS and Orga.	Legal	HR	Average
IS and Orga.	0.091	0.048	0.130	0.090
Legal	0.455	0.238	0.217	0.303
HR	0.455	0.714	0.652	0.607

The maximum vulnerability to corruption risk at the fourth phase is the Human Resources sub-criterion. Indeed, the monitoring of implementation in accordance with standard practice and the stipulation of the specifications and reception as well as the certification of the service rendered are based on the competence and integrity of the human resources involved in this phase. Since despite the legal provisions stipulated by the various General Conditions of Contract (GCC), the intervention of the human element is essential to verify and validate the achievements or deliverables with all that this could entail as risks in the event of adoption of illegal practices.

Table 8: sub-criteria of decision for Phase 5

Phase 5: Authorization and payment				
	IS and Orga.	Legal	HR	
IS and Orga.	1	5	3	
Legal	1/5	1	1/3	
HR	1/2	3	1	
Total	12/3	9	41/3	
With % relative				
	IS and Orga.	Legal	HR	Average
IS and Orga.	0.588	0.556	0.692	0.612
Legal	0.118	0.111	0.077	0.102
HR	0.294	0.333	0.231	0.286

To comment on these results, it should be noted that the information and organizational systems sub-criterion presents the maximum vulnerability to corruption risk at the fifth phase level. One possible explanation for this is that automating scheduling and payment procedures and sharing information transparently reduces the risk of corruption.

5.6. Matrix of Solutions

The matrix of solutions is obtained by summarizing the results of the tables of the sub-criteria for decision-making for each phase.

Table 9: synthesis of the matrix of solutions

	Phase 1	Phase 2	Phase 3	Phase 4	Phase 5
Organization & IS	0.102	0.090	0.686	0.090	0.612
Legal	0.211	0.303	0.102	0.303	0.102
HR	0.686	0.607	0.211	0.607	0.286

As mentioned above, the HR sub-criterion remains the one that presents maximum vulnerability to corruption risk at the majority of phases. This is definitively confirmed by multiplying the matrix of solutions with the averages of relative percentages (see Table 3) as proposed by Saaty.

5.7. Final Result

Applying the formula set out in the descriptive part of the AHP method results in the following result:

Sub-criteria	Vulnerability
Organization & IS	0.179
Legal	0.226
HR	0.593

Public procurement management processes present the maximum vulnerability to corruption risk at the level of the Human Resources sub-criterion, followed by the legal sub-criterion and then that relating to Information and Organization Systems.

6. Conclusion

The importance of the economic, social and environmental issues of public procurement implies the need to better control all its phases from the expression of need to the closure of the project.

To do this, public actors, international organizations and NGOs give a special place to anti-corruption issues in public procurement. Corruption in public procurement is multidimensional, transnational, transcends all categories of agents and affects all sectors.

To make a scientific contribution to this issue, we have tried to review the various issues, regulations and concepts related to corruption in public procurement in order to identify the components of the public procurement management system (phases, risks, actors...). The aim is to identify areas of vulnerability to corruption risk by working on key criteria: the phases of the process (from identification of need to payment) and sub-criteria impacting the process (the Human Resources, information systems, legal texts, and steering ...).

Methodologically, the choice of the Analytic Hierarchy Process (AHP) is justified by its characteristics that allow for consideration of both the independence and interdependence of assessment criteria. The qualitative approach is also used to assess the weights of the different criteria based on interviews conducted with stakeholders in the process of managing public procurement within the Directorate of Administrative and General Affairs of the Ministry of Economy and Finance, the Directorate of Budget, the Directorate of Public Enterprises and Privatization and the General Treasury of the Kingdom as well as representatives of the control, companies and the National Commission for Public procurement. This research site was selected because it is representative of all other public entities operating as public purchasers (texts and tools are identical) and the experience gained in risk management through the Expenditure Management Risk project (RIMAD).

The empirical use of the data collected and the application of the formulas proposed by Saaty have led us to conclude that the Human Resources (HR) sub-criterion presents maximum vulnerability to corruption risk at the level of public procurement management process, and in particular at the first phase on the definition of needs and bidding documents.

However, we have not been able to further explore Phase 1 and the HR sub-test to analyze the reasons and causes that make these two elements most vulnerable to corruption risk. Is this a problem of management and training capabilities? Ethics? Communication and steering? Or motivation? ... All these aspects can be deepened by further research.

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