Anti-Bribery Quantitative Model. An approach based on pair-wise information System

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Abstract: -Organizations strives to develop a relevant anti-bribery management system to comply with mandatory rules. To achieve an efficient model, managers must get an equilibrium among a pure rule oriented organization and an organizing with some degree of freedom, that allows people to choose. The difficulty is how to develop and manage efficiently anti-bribery system in an organization without putting at risk its day by day operation. Managers are concerned how to balance between inflexible control and a flexible way of people work on organization. The purpose of this document is to introduce a decision-making way of defining a context to establish an anti-bribery risk management system in accordance with the best practices. To address this matter, we will support our work in a theoretical framework for the analysis of human work and introduce anti-bribery as non-functional requirement (generic qualities of services) of organization information systems.

Key-Words: - bribery, activity Theory, risk management, Pair-wise comparison

1 Introduction

We find bribery behaviours in a wide set of economic activities and in different countries with distinctive stages of progress. In all situations, it is most likely to happen when public and private sectors cooperate [16]. Corruption can be divided in two groups [16]: petty corruption (i.e. done on the small scale) and grand corruption (that comprise the abuse of high-level power that profits). Both causes severe and extensive damage to overall society.

Three types of benefits are identified during a bribery lifecycle: money, other pecuniary advantages indirectly related with money or non-pecuniary advantages, such as favourable publicity.

This article explains how using Activity theory, decision making and ISO 31000 standard can help to set up an anti-bribery model [7]. Our main goal is to develop an approach to build an anti-bribery enterprise model based on a social theory and that can be implemented in information systems. Our position is that the traditional methods of finding appropriate measures and control rules regarding anti-bribery have limitations and additional improvement is required [19].

The remaining of this paper is organized as follows. Section II describes the Theoretical referential used. Section IV presents our proposed solution. This solution will be used in a case study in section V. Sections VI details some recommendations based on the results and the problems encountered.

2 Support Theory

2.1 Activity Theory

Activity Theory is a broad theoretical framework for the analysis of human action in a specific collective context over time [6]. Historically, we can find several relevant contributions for developing Activity Theory, such as: Vygotsk, founder of the activity theory and Leontjev and Lurija, coined the term "activity" as the basic unit of analysis which is used to understand individual and co-operative actions. Several researchers applied Activity theory to human-computer interaction (HCI), named Kaptelinin, Nardi and Bødker [9][2]. Relevant work, regarding historical analyzing and redesigning people's work, was developed by Engeström[6], applications on information technologies and ergonomics [8].

Originality, according Vygotsky, Leontjev and Lurija [18][12], is an activity which encompassed the following: analytical

component of subject, tool and objective. A subject is an individual worker, their colleagues and co-workers are the participants of an activity. An objective is a plan or common idea that is shared for manipulation and transformation by the members of the activity. Tool is the mediating device through which the work is executed.

Engeström amends the original theory providing two new components of analysis: rules and division of work [6]. Rules are sets of conditions that help to determine how and why individuals may act, and are a result of social conditioning. Division of work provides for the distribution of work among a community of workers. These two elements affect a new plane of reality known as community. Engeström expands the unit of analysis from an individual action to a collective activity (fig1).

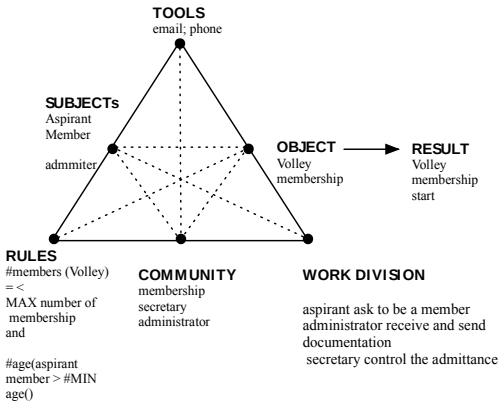

Fig. 1. Activity Diagram.

Vygotsky [18] presents the concept of cultural mediation of human action. That means the relationship between subject and objective is not direct but mediated by tools. Tools incorporate the development of an activity since they are modified over the history of its incorporation into goal-directed human action. Engeström enlarges the concept of mediation to two news concepts of collective activity: rules and division of work.

In activity theory dialect, the basic unit of analysis to understand individual actions is an Activity. An Activity has a layered hierarchical structure comprised by actions or chains of actions, and where these actions comprised operations. This hierarchy is illustrated in fig. 2.

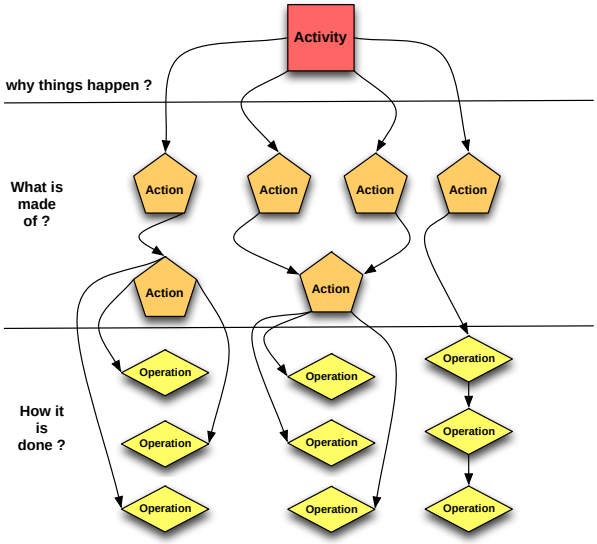

Fig. 2. Activity hierarchical structure.

The specified description of each level is as follows:

- Activity is understood as chains of individual and supportive actions. Activity's actions are connected to each other by the same objective and motive;
- Actions contribute to an activity. Actions have a goal, that can only be understood in the context of corresponding activity;
- Operations are well-defined routines used subconsciously as answers to conditions faced during the performing of the action.

Activities are performed through certain actions which are directed at goals and which, in turn, are implemented through certain operations. The boundary among hierarchical layers can change. An activity can lose its motive and become an action, and an action can become an operation when the goal changes.

2.2 Risk Management

There are many definitions of risk and risk management, some similar and some very different. We accept ISO 31000 concept of risk and risk management [11]. According to ISO 31000 risk is the effect of uncertainty on the ability of an organization to meet its objectives and the concept of risk management is based on a set of generic principles and guidelines to manage risk.

Organization should implement a range of coordinated activities to direct and control regarding the effect of uncertainty. To achieve that, ISO 31000 encompass (fig 1): 1. set of principles; 2. guidelines to risk management framework and 3. description of a risk process.

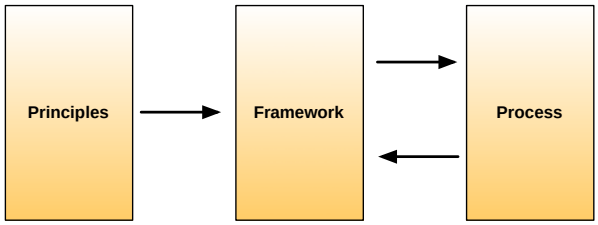

Fig. 3. Structure of risk according ISSO 31000.

The goal of principles is to ensure the creation of a risk management framework, as follows: 1. Produce and safeguard organizational value; 2. Set up organizational processes; 3. Be part of decision making; 4. Clearly address uncertainty; 5. Be systematic, structured, and timely; 6. Be based on the best available information; 7. Be tailor-made; 8. Take into account human and cultural factors; 9.Be transparent and inclusive; 10.Be dynamic, iterative, and responsive to change; 11.Facilitate continual improvement of the organization.

Risk management framework is composed of a set of elements that provide the foundations and organizational arrangements for designing, implementing, monitoring, reviewing and continually improving risk throughout the organization. It uses a systematic application of management policies, procedures and practices of the activities of communicating, consulting, establishing the context, and identifying, analyzing, evaluating, treating, monitoring and reviewing risk through a risk management process.

Risk management process consists of five integrated segments and is present as, essentially the following steps like: 1. Communication and consultation; 2. Monitoring and review, aim to choose the appropriate action as new risks emerge and existing risks modify because of organizational changes; 3. Establishing the context; 4. Risk assessment and 5. Risk treatment.

Communication and consultation encompasses the engagement with internal and external stakeholders, to gain their input to the process and their ownership of the outputs and monitoring and review, aims to choose the appropriate action as new risks emerge and existing risks modify because of organizational changes.

Establishing the context sets objectives, identifies factors that influence success, appraises stakeholder relationships, and identifies the risk management environment. This essential step precedes risk assessment.

Risk assessment consists of three interrelated steps: Risk identification - defines risks, and identifies risk drivers and risk categories; Risk analysis - evaluates risk, including potential business consequences and likelihood occurrences. “Risk evaluation” prioritizes risks ranging from acceptable to unacceptable, and identifies which risks require treatment.

Risk treatment identifies options for treating risks, including: accepting risk to achieve competitive advantage; avoiding risk; reducing or removing the likelihood or consequence of risk; and sharing or transferring risk.

In conclusion risk management can be understood as a risk framework based on a set of principles whose purpose will be to ensure the fulfilment of the goal of organization risk management and includes a risk management process, and the resources, as represented in fig. 3.

2.3 Pair-wise comparison

There are several different techniques to choose from when prioritizing based in different type of comparisons that humans make [15]: absolute and relative. In absolute comparisons, alternatives are compared with a standard or baseline which exists in one's memory and has been developed through experience. In relative comparisons, alternatives are compared in pairs per a common attribute. Thereby, results get different priorities, whereas absolute techniques assign several outcomes to the same priority. Relative approaches tend to be more accurate and informative than absolute ones.

AHP [17] is a pair-wise comparison artefact that supports both types of comparisons, involving comparing all possible pairs of alternatives in a structured and transparent way of making decisions. The methodology of the AHP can be explained in the following steps: 1) decomposition of the problem into a hierarchy; 2) Data collecting corresponding to the hierarchic structure; 3) Create and organize a pairwise comparison of various criteria generated at step 2; 4) Calculate weights with respect to the criteria and ratings with respect to the alternatives; 5) Consistency of the weights is evaluated.

In AHP each decision is broken up into a hierarchy of three components: goal, alternatives and criteria (fig 4).

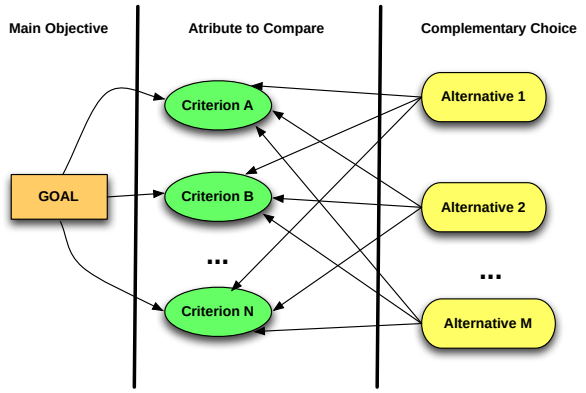

Fig. 4. Hierarchy components of tree decision

Goal is a singular primary objective that drives the decision problem. The alternatives are the different options that are being weighed in the decision. The criteria of a decision problem are the factors that are used to evaluate the alternatives regarding the goal. Each alternative will be judged based on these criteria to see how well they contribute to the goal of the problem.

The outcome of the AHP is a priority vector, which gives us an insight into the best option for the decision makers. Priority vector is calculated using Eigen vector method [15] to achieve pair-wise comparisons and if there are n criteria to prioritize. Consider n criteria to be compared, C_1, C_2 … C_n and denote the relative weight (or priority or significance) of C_i with respect to C_j by a_{ij} and form a square matrix $A=(a_{ij})$ of order n with the constraints that $a_{ij} = 1/a_{ji}$, for $i \neq j$, and $a_{ii} = 1$, all i. The total number of comparisons to perform is n(n-1)/2 and the result is a reciprocal matrix.

A key benefit of this method is that it incorporates a methodology to correct the measurement of attributes by trying to maintain the consistency of weights [15]. The weights are consistent if they are transitive, that is $a_{ik} = a_{ij} * a_{jk}$ for all i, j, and k. For matrices involving human judgment, the condition $a_{ik} = a_{ij} * a_{jk}$ does not hold as human judgments are inconsistent to a greater or lesser degree. We can calibrate the quality of judgments using consistence ratio (CR), used to measure how consistent the judgments have been relative to large samples of purely random judgments. If the CR is much more than 0.1 the judgments are untrustworthy because they are too close for comfort to randomness and the exercise is valueless or must be repeated.

3 Problem Outlook

When fraud occurs within an organization there is often a digital track left behind. It's unavoidable, as there is a record of something related to the fraud. For example, an account balance that was changed, or a simulated collaborator who was added to the payroll system. In this case, some backtracking analysis can help to detect the problem.

Most of frauds related to bribery are

distinctive. They happen separate to the accounting system, so they often don't leave a digital trail. Organizations must rely on vague signs to the existence of such an arrangement.

Typically, bribery happen out of relationships between persons, so to detect them, management must often be aware of the relationships between employees inside and outside organizations. That is undoubtedly a tough mission, that can be breakthrough if we take into consideration the types of benefits that can be identified during a bribery lifecycle: money, other pecuniary advantages indirectly related with money or non-pecuniary advantages, such as favourable publicity.

The conventional to appropriate outcome measures and control policies to avoid bribery have limited trustworthiness and additional improvement is required. It is because this kind of dysfunction is related with organization's human activities, which are so complex that recognizing them accurately is a challenge.

According to activity theory the complexity of work developed by people on organization can only be understood in a unit of context known by activity. Activity can be decomposed in actions, which can be executed by means of operations. People can execute operations in diverse ways. It depends on the context at the moment of execution. The environment of execution is also very complex since activities are often performing simultaneous and interleaved with each other's. The existence of dysfunctions, like bribery, could lead to structural tensions within and between people that generate problems, failures and conflicts. Capturing those tensions could be used to develop a continual improvement of structure of a system of activities, based on the reflection and analysis of the preceding structure, since tasks, either conscious (i.e. actions) or unconscious (i.e. operations) are not rigid and arise from dysfunctions perceived by people.

Pair-wise comparison [17][4][10] can be used to assist in discovering activity dysfunctions perceived by people. This requires providing qualitative assessments for determining, inside an activity, the performance of each action with respect to each anti-bribery criterion and the relative importance of the evaluation criteria with respect to the overall objective of mitigate the possibility of organizational bribery. Without an appropriate methodology, this can result on imprecise and subjective qualitative data, which makes the decision-making process complex and challenging.

Risk management has become an essential activity in developing an anti-bribery model [11][1], allowing organizations to assess risks and identify procedures to mitigate risks. Despite the existence of a consolidated body of knowledge regarding risk, organizations and risk managers struggle to identify the most suitable risk management model that should be used in the anti-bribery risk management process.

4 Proposed Solution Model

We use a quantitative model to analyse, and documenting the model, with the purpose of finding a possibly solution for a decision making anti-bribery model. The model is based on using decision-making [13][14][20]. Next we explain the main model's concepts.

A. **Enterprise**. An enterprise encompasses a set of activities. We symbolize an enterprise by **e and activities by a.**

$$E = \{a \mid a \text{ is an activity } \textbf{and } c \text{ allows to achieve an outcome}\} \quad (\mathbf{d_1})$$

B. **Activity**. Activity is a unit of analysis that describes the work to achieve specific outcome in an enterprise. The work is done by a group of people as a social, cooperative and collective task. We consider three mediation artefacts: **Tools**: influence subject-object interactions (we symbolize by **s-o**). **Rules**: regulating the relation between Subject and Community (we symbolize by **s-c**) and **division of Labour**: the division of activities among community in the activity (we symbolize by **c-o**).

$$a = \{<s\text{-}o>, \ <s\text{-}r>, <c\text{-}o,>\} \quad (\mathbf{d_2})$$

$$<s\text{-}o> =_{def} <<subject, object>, tool>$$

(d3)

<s-r> = def <<subject, object>, rules
(d4)

< c-o> = def << community, object>, word division ***(d5)***

C. **Context**. Context is defined by a subset of *Activities that will be analysed in the perspective of bribery.*

$$C_x = \{a_1, a_2, \ldots, a_n\} \text{ and } C_x \subseteq E \quad \textbf{(d6)}$$

D. **Bribery risk value function** (**BRV_f**) is a function for computing bribery risk value in a specific context for each action (**a**) in the activity. These values are evaluated by some possible measures that can be explored by bribery actions related with mediation artefacts.

$\mathbf{BRV}_{<s\text{-}o>} = f(<s\text{-}o>)$ ***(d7)***

$\mathbf{BRV}_{<s\text{-}r>} = f(<s\text{-}r>)$ ***(d8)***

$\mathbf{BRV}_{<c\text{-}o>} = f(<c\text{-}o>)$ ***(d9)***

E. **Action Bribery Risk Value function**. **$ABrv_f$** is a function for calculating bribery risk value of each action in the current context.

F. **$ABrv_f$** = Median ($f(<s\text{-}o>)$, $f(<s\text{-}r>)$, $f(<c\text{-}o>)$) ***(d10)***

5 Bribery Risk Management Process

In this section, we suggest an anti-bribery context model based on activity theory, risk management and pairwise comparison for capturing and analysing the possibly perceived bribery in an organization by subjects that participate inside the organization. It is grounded on some key concepts of AT, risk management and pair-wise comparison as highlighted in Section II and contributions from [5], [11], [15], [28], [34], [36], [50]. The model consists of the following notations:

4.1 Definition of Unit of Analysis. An activity is a unit of analysis that describes the work to achieve a specific outcome. Activities can share a set of items such as: tools, people, division of work, community, objects, etc. Each activity is unique, since they have distinctive outcome. Inside an activity there is possibility of multiple relationships within the items. However, the main undertaking is always to understand the entire activity rather than their separate connections, since work cannot be understood or examined separately from the unit in which it occurs.

4.2 Definition of an enterprise as a system. An enterprise can be assembled as a system. The construction of a system can be described by enumerating the elements in the composition (i.e., a set of activities inside the enterprise), environment (i.e., a set of activities outside the enterprise), and a structure (a set of influence bonds among the activities in the composition and between them and the elements in the environment).

4.3 Definition of a scope. Scope is defined by a subset of activities that belong to the structure of an enterprise and will be analysed from the viewpoint of bribery. We analyse activities, considering three mediation items (fig.5): Tools: influence subject-object interactions (we symbolize by s-o). Rules: regulating the relation between Subject and Community (we symbolize by s-c) and division of Labour: the division of activities among community in the activity (we symbolize by c-o).

$C_x = \{a_1, a_2, \ldots, a_n\}$ and $C_x \subseteq E$ ***(d6)***

$a = \{<s\text{-}o>, <s\text{-}r>, <c\text{-}o,>\}$ ***(d2)***

<s-o> = def <<subject, object>, tool> ***(d3)***

<s-r> = def <<subject, object>, rules ***(d4)***

< c-o> = def << community, object>, word division ***(d5)***

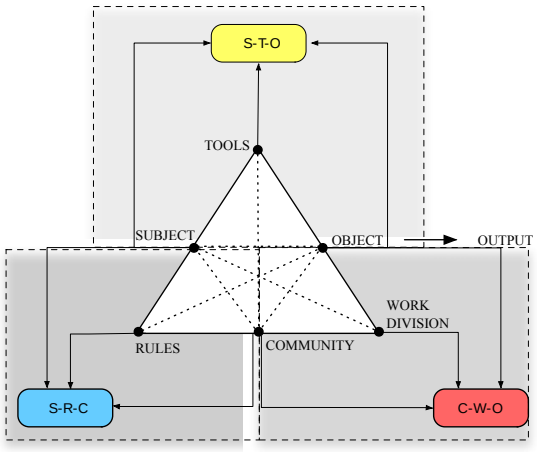

Fig. 5. Activity Mediation items.

4.4 Calculate the Bribery Risk is a function for computing bribery risk value in a specific scope. We define a fundamental scale based on intensity of importance on an absolute scale of bribery, based on AHP fundamental scale [15]. We define a priory value based on pairwise comparison mediations items of each activity and we define a priory vector based on comparison matrices for each action of an activity.

$$\mathbf{BRV}_{<s\text{-}o>} = f(<s\text{-}o>) \qquad (d_7)$$

$$\mathbf{BRV}_{<s\text{-}r>} = f(<s\text{-}r>) \qquad (d_8)$$

$$\mathbf{BRV}_{<c\text{-}o>} = f(<c\text{-}o>) \qquad (d_9)$$

Table 1. Fundamental scale for anti-bribery.

Intensity of importance	Defining	Description
1	Equal importance	two items have the same possibility to contribute to bribery.
3	Moderate importance	Experience and judgment moderate one item over another regarding bribery.
5	Strong	Experience and judgment strongly one item over another regarding bribery.
2,4	Intermediate values	When compromise is needed.

6 Case Study – Bribery Control in Open Enterprise Procurement

For the case study, we will evaluate the bribery risk in a process concerning a specific type of enterprise procurement process, named open procurement.

An open procurement, also called competitive tender, is a bidding process that is public to all qualified bidders and where the sealed bids are opened for scrutiny and are chosen on the bases of some criteria.

The procurement activity initiates by advertising the requirement. Contracts will be attained using competitive, fair and transparent procedures, ensuring equality of opportunity and treatment for all candidates.

Figure 5 presents the activity diagram of such public open procurement.

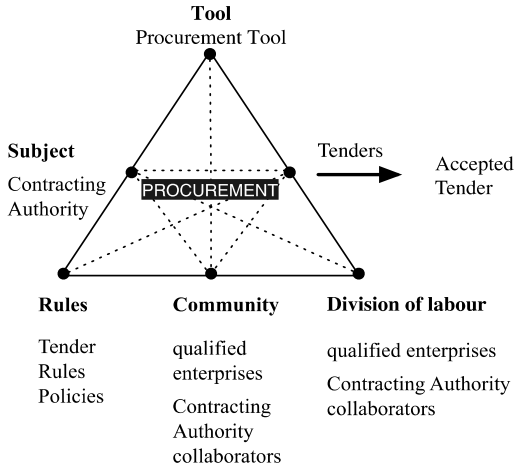

Fig. 5. Enterprise Open Procurement Activity.

Considering open procurement activity, we can describe the following main actions:

i. **Advertising**. A contracting authority advertises the contract opportunity and then issues full tender documents to all enterprises that request to participate;
ii. **Submission of tender**. Enterprises submit both qualification information and tenders in response to the contracting authority's advertised requirements;

iii. **Selection of tender**. Only tenders from suitably qualified enterprises that have submitted the required documents and that meet the selection criteria are considered; Tenders can be evaluated based on defined rules;

iv. **Explanation of tender.** No negotiations are permitted with enterprises, although contracting authorities may clarify aspects of the tender with enterprises.

Fig 6 presents the main actions of open procurement activity. This allows us to capture the model of our system composed of one activity with a set of actions.

ACTIONS	
ACT1	Advertising
ACT2	Submission of tender
ACT3	Selection of tender
ACT4	Explanation of tender

Fig. 6. Actions for Open Procurement Activity.

Fig. 7 describes the criteria weight that will be considered pair-wise comparison of mediation items of open procurement by people involved in it. We notice that the result is consistent (RC= 0.0158) and therefore we can conclude the main risk, concerning bribery could be concerned with rules that mediate the relationship between subject and division of work (S-R-W).

MEDIATION WEIGHT

	S-T-O	R-W-O	S-R-W	Weight
S-T-O	1.000	0.333	0.333	0.1416
R-W-O	3.000	1.000	0.500	0.3338
S-R-W	3.000	2.000	1.000	0.5247
SUM	7.000	3.333	1.833	

ymax	3.0538
IC	0.0269
RC	0.0464

Fig. 7. Mediation Weight.

Fig. 8 outlines pair-wise comparison for tool mediation. We conclude that the main issue is concerning advertising (ACT1) following explanation of tender (ACT4).

ACTIONS EVALUATION FOR S-T-O

S-T-O	ACT1	ACT2	ACT3	ACT4	A (S-T-O)Wv
ACT1	1.000	2.000	3.000	2.000	0.4038
ACT2	0.500	1.000	2.000	0.333	0.1703
ACT3	0.333	0.500	1.000	0.333	0.1055
ACT4	0.500	3.000	3.000	1.000	0.3205
SUM	2.333	6.500	9.000	3.667	

ymax	4.1434
IC	0.0478
RC	0.0531

Fig. 8. Actions Evaluation for S-T-O.

Fig. 9 outlines pair-wise comparison for division of work. We conclude that the main issue is selection of tender (ACT3) following explanation of tender (ACT4).

ACTIONS EVALUATION FOR R-W-O

R-W-O	ACT1	ACT2	ACT3	ACT4	A (R-W-O)Wv
ACT1	1.000	1.000	0.333	1.000	0.178
ACT2	1.000	1.000	0.333	0.250	0.120
ACT3	3.000	3.000	1.000	1.000	0.3790
ACT4	1.000	4.000	1.000	1.000	0.323
SUM	6.000	9.000	2.667	3.250	

ymax	4.2072
IC	0.0691
RC	0.0767

Fig. 9. Actions Evaluation for R-W-O.

Fig. 10 outlines pair-wise comparison for rules mediation. We conclude that the main issue is explanation of tender (ACT4) following selection of tender (ACT3).

ACTIONS PARWISE COMPARATION FOR S-R-W

S-R-W	ACT1	ACT2	ACT3	ACT4	A (S-R-W)Wv
ACT1	1.000	1.000	0.333	0.333	0.124
ACT2	1.000	1.000	0.333	0.333	0.124
ACT3	3.000	3.000	1.000	0.500	0.313
ACT4	3.000	3.000	2.000	1.000	0.4392
SUM	8.000	8.000	3.667	2.167	

ymax	4.0605
IC	0.0202
RC	0.0224

Fig. 10. Actions Evaluation for S-R-W.

Fig. 11 presents the calculation of bribery risk of open procurement activity. This allows us to conclude that the main concerning regarding bribery is the explanation of bribery (ACT4) following selection of tender (ACT3). We also conclude that the rules are the main mediation item that could be explored in the bribery apprehension.

3	S-T-O	R-W-O	S-R-W
WEIGHT	0.142	0.334	0.525

ACTIONS	S-T-O	R-W-O	S-R-W	
ACT1	0.404	0.178	0.124	0.181
ACT2	0.170	0.120	0.124	0.129
ACT3	0.105	0.379	0.313	0.306
ACT4	0.320	0.323	0.439	0.3838

Fig. 11. Total Actions Evaluation for Bribery.

7 Conclusions

In this work, we have explored how to use a combination of social framework, risk management and pair-wise comparison as an approach to the investigation of qualitative measure of bribery perception in the context of human practice.

Using such approach, it is possible to propose a solution model where people subjectively and subconsciously contemplate the several factors in achieving a quantitative value regarding bribery regarding the consciences actions undertaken each activity.

The model is malleable per different settings and provides an accurate assessment. We collect all information from a unit of analysis that facilitate to understand the overall objective.

The bribery control model is supported on a risk assessment model based on using a modified fundamental scale based on intensity of importance on an absolute scale of bribery, grounded on AHP scale.

In future work, we need to contemplate dipper inside an activity, mainly we should look over the operation stage of each action. We also need to contemplate other methods to accurately determine the various factor weights and evaluations.
We consider using other methods, such as fuzzy par-wise comparison [3], since we have to deal with the imprecision and subjectiveness instead of a crisp value of AHP.

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