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Research Article

Evaluating Ethical Responsibility in Inverse Decision Support

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Decision makers have considerable autonomy on how they make decisions and what type of support they receive. This situation places the DSS analyst in a different relationship with the client than his colleagues who support regular MIS applications. This paper addresses an ethical dilemma in "Inverse Decision Support," when the analyst supports a decision maker who requires justification for a preconceived selection that does not correspond to the best option that resulted from the professional resolution of the problem. An extended application of the AHP model is proposed for evaluating the ethical responsibility in selecting a suboptimal alternative. The extended application is consistent with the Inverse Decision Theory that is used extensively in medical decision making. A survey of decision analysts is used to assess their perspective of using the proposed extended application. The results show that 80% of the respondents felt that the proposed extended application is useful in business practices. 14% of them expanded the usability of the extended application to academic teaching of the ethics theory. The extended application is considered more usable in a country with a higher Transparency International Corruption Perceptions Index (TICPI) than in a country with a lower one.

1. Introduction

The ethical dilemma addressed in this paper is represented by a simple case. After his graduation, the first job of a decision analyst was the head of a decision support unit in a governmental agency of a developing country. The most important task he started with was to support the top decision maker of the agency in selecting the best one among several IT companies participating in a tender of a large-scale project. Using the Analytical Hierarchy Process (AHP) of Saaty [1] and considering specialists' judgment on the relative importance of detailed selection criteria, the analyst prepared a report recommending a specific company X that had the best offer. Upon receiving the report and listening to the professional presentation given by the analyst, the decision maker commented: "it is a good work; however, you have to rewrite the report to show that company Y is the most suitable for this project." The problem was defined by the analyst at this moment as "developing criteria for a preselected decision" or "Inverse Decision Support."

There were two notions conflicting in the back of analyst's mind. The first was the notion of "support, not replace decision maker" as recommended by all known DSS textbooks [2–4]. In this notion, the decision maker is the owner of the decision and the decision should reflect her/his preferences and values [5]. The second was the professional responsibility as mentioned in the ACM [6], IEEE [7], and AIS [8], Codes of Ethics and Professional Conduct. Article 2.1 of ACM's Code says explicitly "Strive to achieve the highest quality, effectiveness, and dignity in both the process and products of professional work." [6, page 1]. Resolving this conflict was another decision the analyst had to make.

After a couple of days, the analyst came up with a new report entitled: "The cost of selecting company Y points for negotiation." The report explained the details of loss or gain on each selection criterion in case of selecting the suboptimal company Y rather than the optimal company X. The report also defined some points for negotiation with company Y to substitute such losses and increase gains through other services or products to be provided by the company. This report was considered a proactive type of "Inverse Decision Support."

Decision makers, especially in developing countries, have considerable autonomy on how they make decisions and what type of support they receive. This places the DSS analyst in a different relationship with the client than their colleagues who support regular MIS. In the case of "Inverse Decision Support," the result is fixed in advance by a decision maker, and the role of the decision analyst is to alter the "process" by which the decision is "arrived at" to fit the preconceived result.

The nature of support provided by DSSs can be characterized according to a continuum of passive through to normative support [9]. Passive decision support tends to place the emphasis more on the decision maker to control the decision process, while normative support imposes a structure and process on the decision makers regardless of their preferences or normal style of work [4, 9]. Most DSSs, however, tend to sit somewhere in the middle, offering more structured support whilst respecting the autonomy of the decision maker to control the process. Such systems are labeled by Keen and Morton [4] as "active" DSSs. Active DSSs expose both the decision maker and decision analyst to a range of ethical issues.

This paper addresses an ethical dilemma in "Inverse Decision Support", where the analyst supports a decision maker who has a tendency toward a suboptimal alternative. An extended application of the AHP is proposed for evaluating the ethical responsibility of selecting a suboptimal alternative rather than the optimal one. The extended application is consistent with the Inverse Decision Theory (IDT) that used extensively in medical decision making [10, 11]. The validity of the extended application is checked by measuring decision analysts' perception on its usability.

DSS includes personal support systems, group support systems, executive information systems, online analytical processing systems, data warehousing, and business intelligence applications [2, 12]. This paper focuses on personal decision support system, that is, a system designed to support an individual decision maker with a single specific decision task.

The paper consists of six sections. Section 2 reviews the available literature on the ethical issues in supporting decision making. In Sections 3 and 4, a proposed extended application of AHP for evaluating the ethical responsibility of selecting a suboptimal alternative and an illustrative example are presented. Section 5 demonstrates the measurement of decision analysts' perception on the usability of the proposed extended application. Finally, the conclusion, contributions, and limitations are provided in Section 6.

2. Ethical Perspectives on Supporting Decision Making

Several cases of biased decision making are mentioned in the literature [13–16]. Bias includes the situation where the decision maker has predetermined the decision based upon her/his own prejudices [17]. In this case, the decision maker asks the decision analyst to develop justification for her/his predetermined decision rather than to help her/him reaching the optimal one. Such case is defined in this paper as "Inverse Decision Support."

However, the ethics of decision making as a specific topic has received very little attention in comparison to the issues of privacy and other general IT ethics issues [18]. Based upon detailed statistics of the literature, Meredith and Arnott concluded that "indeed, there is a major gap in the literature on this topic" [18, page 1566].

Ferrell and Gresham [19] believe that there is no such thing as an "ethically neutral" decision making. All decisions are based on a set of values, which are representative of an ethical viewpoint. The most commonly used moral philosophy seen in research is that of utilitarianism [20, 21]. Utilitarianism believes that a useful decision is by definition a good decision. Therefore, the determining considerations of right conduct should be the usefulness of its consequences. On the other side, we may consider the level of ethical responsibility of suboptimal selection as a function of the total losses due to this selection on all criteria.

According to the issue-contingent model provided by Jones [22], the ethical decision-making process begins with the environmental factors outside the organization such as social influences, cultural expectations, or economic conditions. These environmental factors often invoke an ethical dilemma and provide a context for making the ethical decision. The second step of the model is the recognition of a moral issue that deserves further ethical evaluation, which entitled the "moral intensity" of the issue. Jones [22] identifies six characteristics of the issues that define moral intensity, which are the magnitude of consequences, social consensus, probability of effect, temporal immediacy, proximity, and concentration of effect. The third step is the ethical judgment based upon the cognitive moral development, moral philosophies, or the ethical value system of the individual [23–25]. Carlson et al. [26] provide an extension to Jone's model, which considers the potential contribution of DSS within the ethical model in such a way that a decision maker's engagement in a certain behavior is moderated by her/his use of DSS.

Johnson and Mulvey [27] address the issue of responsibility for outcomes resulting from decisions made based, in part, on advice provided by a DSS. They believe that the decision analysts should have similar responsibilities as any other professional or expert who is hired for her/his advice. That is, decision analysts should bear responsibility for the quality of the advice their DSS provide. They should also establish standards and norms for the ethical use of their systems.

Chae et al. [28] raise the issue of analyst's responsibility to check whether or not the correct decision is being supported. They point out that ignoring the stakeholders value positions in a decision problem can lead to the wrong problem being supported.

Fox [29] addresses the ethical issue in expert systems. Expert systems have a significant level of autonomy to make decisions and undertake corresponding actions. If an ethically questionable decision is made, the moral responsibility potentially resides with the system designer.

Meredith and Arnott [18] believe that the framework for ethical medical DSS [30] is useful for DSS in general. The framework includes four bioethical principles, which are beneficence, nonmaleficence, autonomy, and justice. Beneficence means an act of commission and nonmaleficence means the omission, both aimed at ensuring that, in the medical setting, the “good” for the patient is maximized and the “bad” is minimized. Beauchamp [31] derives four directives from the first two principles, which are not to inflict evil or harm (nonmaleficence), to prevent evil or harm (beneficence), to remove evil or harm (beneficence), and to do or promote good (beneficence). The aim of DSS analysts is to support decision makers positively within the context of a decision problem. As professionals, they should avoid introducing negative factors, which exacerbate the cognitive biases of the decision maker [17]. Analysts must be aware of the full consequences of their actions in satisfying the principles of beneficence and nonmaleficence [31].

Oliver and Twery [32] believe that human nature ensures biases including biases in decision making. Since bias will always exist, it is important for both the decision maker and the analyst to understand the possible influences this bias may have on decision making. Danielson [33] presents a computational representation and evaluation of imperfect, imprecise user statements in decision analysis.

Keeney [34] goes to great lengths to make sure that an analyst gets the right objectives before starting decision analysis. He recommends that the right objectives measure what the decision maker really cares about. The case when a decision analyst discovers that a decision maker really cares about an unethical hidden criterion has not been discussed.

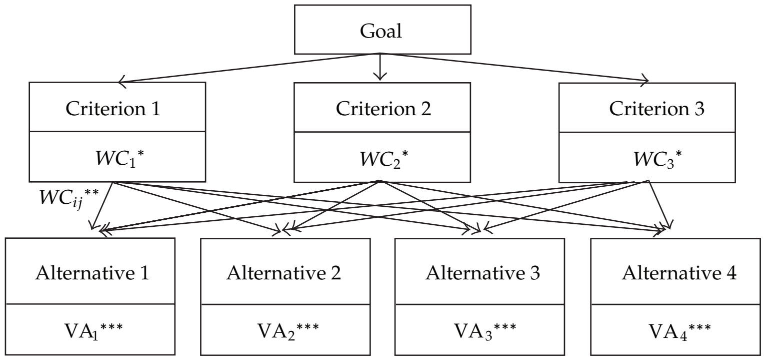
The concept of utility loss due to inefficient decision making dates back to the work of Barron [35]. Typically the concept has been used to measure the quality of the decision and not an ethical dilemma [36].

IDT is used mainly in medical decision making when there is a widely accepted treatment strategy, to determine the space of losses associated with such strategy [10]. In the IDT, a Bayesian approach is used to estimate the probabilities associated with the diagnostic tests and make inferences about the region in loss space where these medical procedures are optimal [11].

Reviewing the available literature shows the importance of considering ethical issues in supporting decision making. Supporting the selection of suboptimal alternative in decision making is considered mainly a quality issue rather than an ethical issue. Models that discuss ethical issues in supporting decision making are descriptive in nature. The magnitude of bias consequences is different for each suboptimal alternative of the same decision problem. However, measuring the magnitude of bias consequences for each suboptimal alternative has not been addressed explicitly in any of the available literature. This paper attempts to contribute to filling this gap.

3. A Proposed Extended Application of the AHP for Evaluating Ethical Responsibility

The AHP is a comprehensive framework designed to cope with both the rational and the irrational when decision makers make multiobjective multicriterion decisions about any number of alternatives considering both qualitative and quantitative aspects [37]. The AHP approach systematically solves complex problems by decomposing the structure of a problem



* WC_j, $j = 1, n$ is the local priority of criterion j where j from 1 to n.
** W_{ij}, $i = 1, m$, $j = 1, n$ is the local priority of alternative i on criterion j where i from 1 to m.
*** VA_i is the total priority of alternative $i = \sum_j W_{ij} * WC_j$, for all values of i.

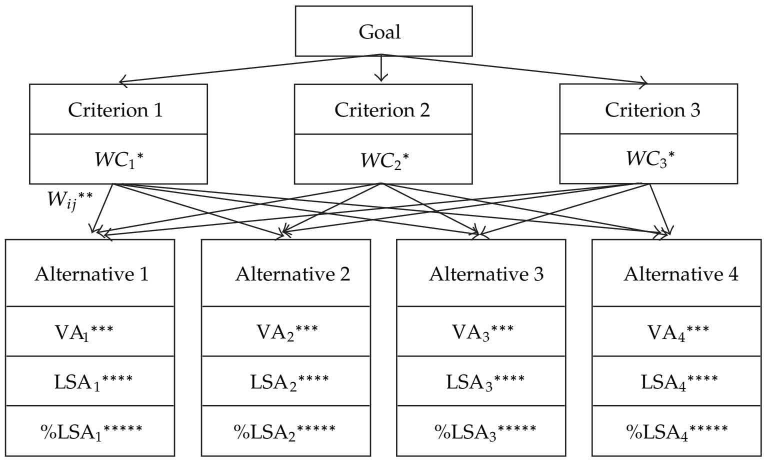
Figure 1: The conventional AHP decision model.

into hierarchies and the users then make pairwise comparison judgments of importance or preference to develop priorities in each hierarchy [1, 38].

The use of AHP has been extended and integrated with several other methodologies. Li and Ma [39] and Ahmad et al. [40] integrate the AHP and the data envelopment analysis (DEA) for improving the efficiency of solution. Nieto-Morote and Ruz-Vila [41] and Thomaidis et al. [42] present methodologies of embodying techniques of fuzzy sets theory into the classical multicriteria decision analysis to handle the subjectiveness that often characterizes expert judgments on a decision problem. Kabil and Kabeil [43] and Onesime et al. [44] integrate the AHP with the quality function deployment (QFD) methodology. However, these methodologies are mainly used for improving the process of decision making rather than dealing with an ethical dilemma.

The original AHP decision model is constructed in three steps [1]. The first is to structure a decision making problem in a hierarchy of goal, criterion, subcriterion (if needed), and alternative levels. The second is to pairwise compare the criteria/subcriteria for assigning their local priorities and for every criterion/subcriterion, pairwise compare the alternatives to obtain a series of local priority matrices. A ratio of relative preference is assigned to each paired comparison according to linear nine-point scale from 1 to 9 and their reciprocal, where 1 means "equally preferred pair" up to 9, which means one element of a pair is "extremely preferred" over the other element. The third step is to synthesize the comparisons by multiplying local priorities (W_{ij}, $i = 1$ to m alternative, $j = 1$ to n criterion) times the local priority of the respective criterion (WC_j, $j = 1$ to n criterion) and the results are summed up to produce the total priority or ranking of each alternative (VA_i, $i = 1$ to m alternative) as depicted in Figure 1.

Then, the model selects the alternative with the highest total priority (rank) as the best or optimal alternative to the goal. Sensitivity analysis may be conducted to test the impact of any change in the local priorities on the resulted decision [45]. However, the conventional model does not directly show the local loss or gain on each criterion or subcriterion due to selecting a suboptimal alternative. Even though the value of such local loss or gain and hence



* WC_j, $j = 1, n$ is the local priority of criterion j where j from 1 to n.
** W_{ij}, $i = 1, m$, $j = 1, n$ is the local priority of alternative i on criterion j where i from 1 to m.
*** VA_i is the total priority of alternative $i = \sum_j W_{ij} * WC_j$, for all values of i.
**** LSAi is the total loss due to selecting alternative $i = \sum_1 (W_{bj} - W_{ij}) * W_{bj}$, where W_{bj} is the local priority of the best alternative on criterion j.
*****%LSA_i is the percentage of loss due to selecting alternative $i = (LSA_i / VA_b) * 100$, where VA_b is the total priority of the optimal alternative.

Figure 2: The proposed extended application of the AHP decision model.

the magnitude of consequences on each criterion or subcriterion can vary significantly from one suboptimal alternative to another.

The proposed extended application of the model represents a mechanism for evaluating the ethical responsibility based upon calculating the local loss or gain on each criterion/subcriterion and the total losses due to selecting a suboptimal alternative rather than selecting the one with the highest total priority (optimal alternative) as depicted in Figure 2. The total losses are also calculated as percentages of the optimal alternative's total priority.

The total loss due to selecting a suboptimal alternative is calculated as the summation of the difference between the local priority of optimal alternative and local priority of suboptimal alternative on each criterion times the weight of the criterion. The percentage of loss due to selecting a suboptimal alternative is calculated as the total loss divided by the total priority of the optimal alternative times 100. In the new structure, two rows are added to alternatives level with the total loss and the percentage of loss.

As shown in the proposed extended application of AHP decision model, having a lower local priority of a suboptimal alternative does not mean that it has lower local priority on all criteria. Despite the total priority of all suboptimal alternatives are less than the total priority of the optimal one, some local priorities of suboptimal alternatives on a criterion may be larger than the local priorities of the optimal alternative on that criterion as shown in the following illustrative example for companies 1, 3, and 4 on the price criterion and company 3 on the performance criterion. In other words, the suboptimal companies 1, 3, and 4 are better than the optimal company 2 on the price criterion and the suboptimal company 3 is better than the optimal company 2 on the performance criterion. The proposed extended application is illustrated by the following numerical example.

Table 1: Local and total priorities of alternatives.

	Price $WC_1 = 0.2$	Performance $WC_2 = 0.5$	Services $WC_3 = 0.3$	Total priority
Company 1	0.33	0.19	0.11	0.194
Company 2 (optimal)	[0.11]	[0.29]	[0.47]	[0.308]
Company 3	0.26	0.43	0.05	0.282
Company 4	0.30	0.09	0.37	0.216

4. Illustrative Example

Four Companies Participate in a Tender

The author's assumed criteria for selecting the tender winner are price, Performance, and Services. The corresponding relative preferences of the criteria based upon pairwise comparisons are 0.2, 0.5, and 0.3. On the price criterion, the local priorities of the four companies are 0.33, 0.11, 0.26, and 0.30, respectively. In such context of preferences, a lower price will have higher priority than a higher price, so, the "Price" criterion actually means "Price Justification". On the performance criterion, the local priorities of the four companies are 0.19, 0.29, 0.43, and 0.09, respectively. On the services criterion, the local priorities of the four companies are 0.11, 0.47, 0.05, and 0.37, respectively.

So, the total priority of company 1 is calculated as 0.33 * 0.2 + 0.19 * 0.5 + 0.11 * 0.3 = 0.194. The same process is carried out for calculating the total priority of company 2 as 0.308, of company 3 as 0.282, and of company 4 as 0.216.

Table 1 represents the lower part of a hierarchy similar to the hierarchy depicted in Figure 2. As shown in Table 1, the optimal company to execute the project is the company with the highest total priority which is company 2.

In case of choosing for the project execution a suboptimal company (i) rather than the optimal company (b), which is company 2 in this example, the total losses would be assessed as

$$\sum_j \left(Wb_j - W_{ij}\right) * \ WC_j, j = 1 \text{ to } n \text{ criterion } \& \ i = 1 \text{ to } m \text{ alternative}, \tag{4.1}$$

where Wb_j is the local priority of the optimal company (Wb) on Criterion (j), W_{ij} is the local priority of suboptimal company (i) on Criterion (j), and WC_j is the local priority of Criterion (j). This expression gives for each company the total losses on all criteria.

So, the total loss due to selecting company 1 instead of company 2 is (LSA_1) = (0.11–0.33) $*$ 0.2 + (0.29–0.19) $*$ 0.5 + (0.47–0.11) $*$ 0.3 = 0.114. And, the percentage of loss due to selecting company 1 instead of company 2 is (%LSA_1) = (0.114/0.308) $*$ 100 = 37.01%.

The same process is carried out for calculating the total loss and percentage of loss due to selecting company 3 instead of company 2 as 0.026 and 8.44%. It is also carried out for calculating the total loss and percentage of loss due to selecting company 4 instead of company 2 as 0.092 and 29.87%.

The extended application proposed in this paper shows the different levels of loss for suboptimal alternatives. It is clear from Tables 2 and 3, that selecting the suboptimal company 3 for the project execution is less harmful than selecting the suboptimal company 1. The level of losses which reflects the magnitude of decision consequences is a key factor

Table 2: Loss on each criterion due to selecting a suboptimal company.

	Price $WC_1 = 0.2$	Performance $WC_2 = 0.5$	Services $WC_3 = 0.3$	LSA	% LSA
Company 1	−0.22*	0.10	0.36	0.114	37.01%
Company 2 (optimal)	0	0	0	0	0.00%
Company 3	−0.15*	−0.14*	0.42	0.026	8.44%
Company 4	−0.19*	0.20	0.10	0.092	29.87%

*Negative loss means a gain on this criterion.

Table 3: The proposed priority-loss matrix.

	Price $WC_1 = 0.2$	Performance $WC_2 = 0.5$	Services $WC_3 = 0.3$	Total priority	LSA	% LSA
Company 1	(0.33)*	0.19	0.11	0.194	0.114	37.01%
Company 2 (optimal)	[0.11]	[0.29]	[0.47]	[0.308]	0	0.00%
Company 3	(0.26)*	(0.43)*	0.05	0.282	0.026	8.44%
Company 4	(0.30)*	0.09	0.37	0.216	0.092	29.87%

*Local priority of suboptimal alternative is higher than the local priority of the optimal alternative.

in determining the ethical responsibility of the decision maker according to Jones's model discussed in Section 2.

The proposed application of AHP decision model, illustrated above, can be used for several purposes.

(1) determining the total loss due to the selection of a suboptimal alternative rather than the optimal alternative (the one with the highest total priority);

(2) determining the local loss or gain on each criterion due to the selection of a suboptimal alternative rather than the optimal one;

(3) raising points for negotiation with the preselected suboptimal alternative to be acceptable for winning the tender; The negotiation points are based upon the local loss or gain on each criterion due to the selection of this suboptimal alternative rather than the optimal one;

(4) indicating the differences in the magnitude of consequences that determine the level of responsibility in cases of taking each one of the suboptimal decisions rather than the optimal one.

However, the practical usability of the proposed extended application is based upon the perception of decision analysts on decision support ethics. The measurement of the analyst's perception is the subject of next section.

5. Perception of Decision Analysts on Model Usability

The main ethical issues that affect the usability of the proposed extended application were built in a test case scenario. Each participant was asked to describe the ethical dilemmas faced in the test case from her/his moral agent's point of view [46]. Then, the proposed extended application was introduced to the test subjects and used to make further analysis on the test case. After using the extended application, the test subjects reassessed their original choices and were asked if they would change their decision. The perception of decision analysts on the usability of the proposed extended application was concluded.

5.1. The Test Case

Each participant of the test case was presented with the following scenario. Last year a governmental agency was having a new tender for building a national IT backbone network. Four large companies (X, Y, Z, and W) submitted different bids for the design and implementation of the system. You work for this governmental agency as a decision support analyst.

The head of agency formed a team of three decision support analysts (W, F, and R) for surveying and selecting the candidate executer of the national IT backbone network project. The team collected data from all available related sources. The team defined all relevant criteria and relative preferences of all types of users including the head of agency. After reviewing all proposals, the team arrived consensually to a conclusion that company X is the best candidate for the project. The report with findings was presented to the head of the agency.

However, the head of the agency did not accept the report and asked the team to reinvestigate the issue because he believed that company Y is the most suitable for this project. The only justification he gave was his own feelings.

All the team members agreed on the subjectivity of the head of agency but they could not reach an agreement on what their further course of action should be. Their alternatives ranged from quitting the team, to following the new decision of the head, to pursuing corrective measures.

Member W asked to withdraw from the team because he could not cooperate with a biased decision maker (as he believed) and at the same time he could not afford fighting him. Member F asked to follow the selection of the head since he was the owner of the decision and he was the responsible for the decision consequences. Member R asked for more analysis on the cost of selecting company Y rather than the company with the best offer (company X) and to pursue corrective measures.

The test subjects were asked to describe the ethical dilemma in the three different reactions of the decision analysts in the test case and choose the reaction, that is, the most close to her/him. The HARPS methodology [47] explains that the case will be perceived differently because each person approaches a situation from her/his own perspective. When a participant was asked to describe the ethical dilemma faced in the test case, in fact, she/he was asked to describe the case from the moral agent's point of view and this view changed from a participant to another [46]. Accordingly, it was expected that the usability of the proposed extended application would be perceived differently.

5.2. The Test Group

The test group consists of 44 decision analysts from two countries with different Transparency International Corruption Perceptions Index (TICPI) [48]. The first country has a high TICPI (6.3) and the second one has a low TICPI (3.1). According to the 2010 index, the TICPI is ranging from 9.3 (the least corrupted country) to 1.1 (the highly corrupted country), where 5.0 is the borderline distinguishing countries that do and do not have serious corruption problems.

In addition to the environment, the context of the test subjects' personality may have also an influence on the persons' moral decisions. Therefore, the participants' gender, age, education, work experience, religious doctrines, ethnic background, and whether they perceive themselves to be ethically minded or not were recorded. Thirty-five (80%) of the test subjects perceive themselves to be ethically minded.

Since the presented case was business oriented, the duration of employment was found to be a crucial factor. Those who had less than 1 year or no work experience and were unfamiliar with the business environment approached the situation differently. Subjects with more work experience were more sensitive to issues at the business environment and their solutions. They were capable of taking more factors into account than those without that degree of professional experience. The educational background of the subjects included 16 undergraduates (senior MIS students), 19 holding a Bachelor's degree (MBA students), and 9 holding a post graduate degree (MBA students). Most of the test subjects (66%) had no background in ethics theory. The other factors including gender did not indicate any or at least not any clear correlations to the decisions made. The test variables and values are listed in Table 4.

5.3. The Test Results

The four responses that answered "Not Clear" on the "Case Information" question are excluded. A paired-samples t-test was conducted to compare the perception of ethical dilemma before and after using the tool. There was a significant difference in perception of the Ethical Dilemma before using the proposed extended application ($M = 1.65$, $SD = 0.7$) and after using it ($M = 2.28$, $SD = 0.91$), and at 95% confidence interval of the difference, the Sig. (2-tailed) value $P = 0.004$. The Pearson correlation coefficient between the analyst's perception on the usefulness of proposed extended application and the difference in perception of Ethical Dilemma is 0.63.

A paired-samples t-test was also conducted to compare the analyst's decision before and after using the tool. There was a significant difference in Analyst's Decision before using the proposed extended application ($M = 1.65$, $SD = 0.7$) and after using it ($M = 2.57$, $SD = 0.87$), and at 95% confidence interval of the difference, the Sig. (2-tailed) value $P = 0.000$ (less than the decimal places shown). The Pearson correlation coefficient between the analyst's perception on usefulness of proposed extended application and the difference in Analyst's Decision is 0.67.

About 80% of participated analysts considered the proposed extended application useful. After using the proposed extended application, 73% of participated analysts changed their decision and 78% of them changed their perception of the Ethical Dilemma. These results suggest that using the proposed extended application does have significant impact on changing the perception of the Ethical Dilemma and Analyst's Decision. Specifically, the results suggest that the respondents consider the proposed extended application useful.

The results also show that the responses of the test subjects were different from one environment (country) to another, which indicates that the environment has a significant impact on the ethical choices of individuals and consequently on the usability of the extended application. In the country with higher TICPI, almost 84% of the test subjects considered the proposed extended application useful and in the country with lower TICPI, only 73% of the test subjects considered the proposed extended application useful. Despite some responses consider the proposed extended application not useful, the values of their answers were positively changed by using the model.

Table 4: Test variables and values (44 subjects).

SN	Variable	Variable description	Scale	Scale description	Values
1	Env	Ethical environment	1	Country with TICPI 6.3	26
			0	Country with TICPI 3.1	18
2	Gen	Gender	1	Male	28
			0	Female	16
3	Age	Age group	1	From 20 to <30	19
			2	From 30 to <40	15
			3	From 40 to 50	10
4	Edu	Education level	1	Undergraduate student	16
			2	Bachelor degree	19
			3	Postgraduate degree	09
5	Exp	Work experience	1	Less than 1 year	10
			2	From 1 to <5 years	20
			3	From 5 to <10 years	09
			4	More than10 years	05
6	Rel	Perceived as religious believer	1	Conservative believer	16
			2	Moderate believer	22
			3	Liberal	6
5	Eth	Ethical background	1	Has ethical background	15
			0	Has no ethical background	29
8	EthM	Perceived as ethically minded	1	Perceives herself/himself as ethically minded	35
			0	Does not perceive herself/himself as ethically minded	09
9	DelB	Ethical dilemma before using the model	1	Supporting the decision maker versus replacing her/him	23
			2	Supporting only the right decisions versus supporting all decision maker's queries (truth versus loyalty)	16
			3	Defending your selection versus withdrawing from the process	05
			4	Other	00
10	DecB	Subject's decision before using the model	1	Follow the selection of the decision maker	23
			2	Withdraw from the team	16
			3	Calculate the cost of selecting suboptimal alternative and pursue corrective measures.	05
			4	Other	00
Reinvestigate the test case after using the proposed extended application					
11	DelA	Ethical dilemma after using the model	1	Supporting the decision maker versus replacing her/him	13
			2	Supporting only the right decisions versus supporting all decision maker's queries (truth versus loyalty)	14
			3	Defending your selection versus withdrawing from the process	14
			4	Others: local versus global optimization	03

Table 4: Continued.

SN	Variable	Variable description	Scale	Scale description	Values
12	DecA	Subject's decision after using the model	1	Follow the selection of the decision maker	11
			2	Withdraw from the team	06
			3	Calculate the cost of selecting suboptimal alternative and pursue corrective measures	24
			4	Others: contacting a higher authority, contacting public media, and negotiating with company Y to improve its bid.	03
13	Mod	Model usefulness	1	Useful	32
			0	Not useful	12
			—	Cannot evaluate it	00
14	Case	Case information	1	Clear	40
			0	Not Clear	04

Interestingly, the subjects who perceived themselves not ethically minded had the same attitude toward the proposed extended application in both countries. The same portion (almost 75%) of this category considered the proposed extended application not useful, which implies that the environment has no significant impact on subjects who perceived themselves not ethically minded.

When asked to frame the problem, 56% of the test subjects identified "supporting the decision maker versus replacing her/him" as the ethical problem. A smaller part of the test subjects (40%) framed the problem as "Truth versus Loyalty" with solutions that ranged from following the decision maker to withdrawing from the system. The majority of the test subjects (91%) pointed out that the test case presented enough information to be framed correctly. However, some of them (20%) considered the proposed extended application not useful.

More than half of the participants started with a decision to follow the selection of the decision maker (57.5%). One of the interesting comments of test subjects was that "the experience and intuition of the head of the agency may allow her/him to make a better decision than the decision of the analyst which was based purely on the analysis of quantitative indicators." However, almost half of them changed their decision after using the extended application. This portion of the test population is viewed as those who have gained a positive outcome from using the proposed extended application. The subjects who changed their decision after using the extended application could be divided into two groups. The first one (86%) changed their decision to calculate the cost of selecting suboptimal alternative on each criterion and pursue corrective measures. The second group (14%) changed their decision to other decisions such as contacting the higher authority, contacting public media, and negotiating with Company Y to improve its bid.

In general, 80% of the participants considered the proposed extended application useful in business practices. Moreover, the extended application could be used in academic teaching. Some of the comments on the usefulness of the extended application suggested using it in academic teaching of the Ethics Theory.

6. Conclusion

The paper addresses an ethical dilemma in "Inverse Decision Support," when the analyst supports a decision maker who requires justification for a preconceived selection that does not correspond to the best option resulted from the professional resolution of the problem. An extended application of the AHP model is proposed for evaluating the ethical responsibility in selecting a suboptimal alternative. A survey of decision analysts is used to assess their perspective of using the proposed extended application.

According to the results, 80% of the participants considered the proposed extended application useful in business practices. Some participants expanded the usability of the extended application to academic teaching of ethics theory. The extended application was considered more usable in a country with a higher TICPI than a country with a lower one.

There are three contributions in this paper. First, the notion of "Inverse Decision Support" is addressed as a new concept of dealing with detailed consequences and negotiation options of predetermined decisions. Second, the paper proposes an extended application of the AHP that enables the analyst to calculate the utility losses due to selecting a suboptimal alternative rather than the optimal one and the associated local loss or gain on each criterion. The third contribution is the measuring of decision analysts' perception on the usability of the proposed extended application in determining the ethical responsibility of suboptimal selection.

The main limitations of the paper are the narrow scope of both the extended application usability and perception measurement. The proposed extended application is limited to active decision support with focusing on single decision maker. It needs more study on sharing ethical responsibility of suboptimal selection among members of group decision making. The sample used for measuring decision analysts' perception on the proposed extended application is small and limited to only two environments with different levels of TICPI.

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