

Using Satisfaction Analysis to Predict Decision Quality

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ABSTRACT

One of the most important factors to determine the success of an organization is the quality of decisions made. In order to improve the decisions taken and to strengthen the competitiveness of organizations, systems such as Group Decision Support Systems (GDSS) have been strongly developed and studied in recent decades. The amount of GDSS incorporating automatic negotiation mechanisms, such as argumentation, is increasing nowadays. The evaluation of these mechanisms and the understanding of their real benefits for the organizations is still a hard challenge. In this article, we propose a model that allows a GDSS to measure the participant's satisfaction with the decision, considering aspects such as problem evaluation, personality, emotions and expectations. To create the model some assumptions are deducted from literature, as well as the premises needed to validate any decision satisfaction model. This model is intended to enable the understanding of the decision's quality achieved with an argumentation system and to evaluate its capability to potentiate the decision's quality. The proposed model validates all the assumptions found in the literature regarding the participant's satisfaction.

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Mathematics Subject Classification: 90B50, 91B10, 68U99

Computing Classification System: H.4.2, I.2.0, I.2.3

1. INTRODUCTION

Nowadays the decisions made by managers and executives are mostly performed in groups. Thereby, group decision-making is a process in which a group of people, called participants, act collectively analysing a set of variables, considering and evaluating the available alternatives in order to select one or more solutions. The number of participants involved in the process is variable and all of them may be either at the same place at the same time or geographically dispersed at different times (Luthans, 2005).

It is a known fact that the amount of hours a decision-maker spends in a meeting is not mostly used to make decisions. The time spent on things like social issues, is responsible for consuming the majority of the time of a process (Mintzberg, 1973; Argyris and Schon, 1974; Hoffman, 1979).

Aiming to improve the decision quality and to facilitate its making in certain scenarios GDSS have been subject of studies in the last decades. One of the great problems associated to the use of GDSS is the difficulty to understand the decision makers' satisfaction with the decision made, problem that also exists in decision processes that do not use a GDSS. Being satisfaction a strong indicator of the taken decision quality in the perspective of each participant, its study is very relevant. Higgins (2000) says that "a good decision has high outcome benefits (it is worthwhile) and low outcome costs (it is worth it)", and that "independent of outcomes or value from worth, people experience a regulatory fit when they use goal pursuit means that fit their regulatory orientation, and this regulatory fit increases the value of what they are doing". With this, it is possible to understand that the decision quality in the perspective of each participant is related to what he considers relevant. Satisfaction is therefore a strong indicator, not only of the results, but also of the whole decision process. When someone is questioned about the quality of a decision, the answer does not reflect only the assessment of outcomes, but also, even unconsciously; it includes the evaluation process necessary to reach the decision. To understand how suitable a decision is, it is necessary to understand and analyse the means to reach that decision (Beach, 1990; March, 1994). Thus, one should give prominence to the process, when drawing conclusions about the results.

There is a great variety of factors responsible for affecting the satisfaction of a decision-making element with the decision made in a meeting: emotional variables (affective components) (Liljander and Strandvik, 1997; Oliver *et al.*, 1997; Wirtz and Bateson, 1999), the process (Simon, 1955; Simon, 1967), the outcomes (Higgins, 2000), the factors that affect the situation (Bailey and Pearson, 1983) and expectations (Sherif and Hovland, 1961; Rodríguez del Bosque *et al.*, 2006).

Briggs *et al.* (2003) presented a theory of meeting satisfaction, which explains the causes of conflicting research results on meeting satisfaction, as these results have never been fully explained in the group support systems literature. Therefore, their theory tries to contribute to a possible development of systems and methodologies that increase group efficiency and group effectiveness, without decreasing meeting satisfaction. The authors proposed and tested the Satisfaction Attainment Theory (SAT) – a causal model of meeting satisfaction. Taking into account the SAT assumptions, satisfaction, i.e., the affective arousal with a positive valence a person felt after a meeting would be a function of the perception that, balancing conflicting and mutually exclusive goals, the value of one's goals increased, or the likelihood of their success increased because of the meeting. Meetings that produce positive Perceived Net Goal Attainment (PNGA) should also produce high levels of meeting satisfaction and meetings that produce negative PNGA should also produce low levels of meeting satisfaction. Finally, Briggs *et al.* (2003) have defined meeting satisfaction as an affective arousal with a positive valence of a participant towards a meeting. However, other researchers may choose to define meeting satisfaction according to other factors, such as the degree to which a meeting has fulfilled certain requirements. The difficulty to provide a clear definition of meeting satisfaction reduces the degree to which research on meeting satisfaction can be generalized.

Tian *et al.* (2008) conducted a study on how to measure satisfaction based on the emotional space. The satisfaction measured sought to understand the users' acceptance for a product by testing

usability. In order to analyse the emotional space, they used the PAD (Pleasure, Arousal and Dominance) model proposed by Mehrabian and O'Reilly (1980). To find out his initial emotional state the user must answer to the Big Five Inventory questionnaire (John *et al.*, 1991), and with the obtained personality he is given a standard emotional state. The emotions generated during the test are detected by observing the user's behaviour. These emotions decay through the process, getting closer to the initial state, as can be seen in Figure 1:

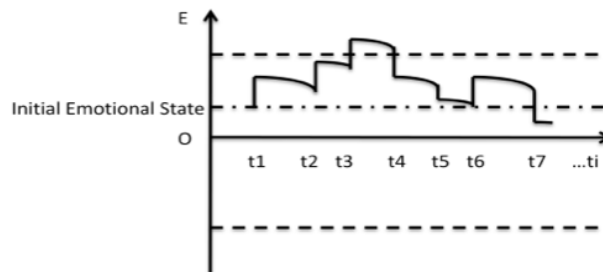


Figure 1. Changes of Single Dimension in PAD Model, adapted from Tian *et al.* (2008)

After performing the test and building the emotional map, emotions' changes are registered and their sum is calculated. With the emotional values, interesting conclusions are attained. The authors claim that "with a good pleasure emotional state, users can have a smooth thinking and judgment to choose the most effective method to finish the task, so the pleasure state of the users can reflect the affinity and usability of the product in the testing. The arousal degree has a positive effect on usability, but the high level of arousal means that users are in a highly concentrated spirit and get tired easily; on the other hand, also means that users may be thinking about a way to solve the problems. So a lower level of positive arousal degree reflects the usability of the software operations. The improvement of the user domination means that users are in an intense state, and that has a negative effect on usability. High usability products should be consistent with the users' traditional habits, without the need to consider the controllable process and solutions of the product. Therefore, the domination degree indirectly reflects the extent of the ease of using the product."

In their work, Paul *et al.* (2004) explore how the performance of a GDSS affects the different satisfaction dimensions. They focus on three indicators of group performance, namely: the decision time, the efficiency in decision-making and the number of iterations in the group decision-making process. For each one of these indicators hypotheses that affect satisfaction are created. Example: "H1a – In a GDSS-supported group decision, the higher the decision time, the lower is the satisfaction of a group with the system used by its members." This model is based on hypotheses and can be verified in Figure 2:

Some of the conclusions obtained from this work demonstrated that the performance of GDSS influences the group members' satisfaction. When decision time increases, the system appears to be unproductive and the group members' satisfaction with the system decreases. However, when GDSS meetings end quickly, members may perceive that they are rushed through the process and different

alternatives of the decision situation are not adequately evaluated. This is evinced in the positive relationship between decision time and the members' satisfaction with the process. The authors found a positive relationship between thoroughness of decision-making and group members' satisfaction with the decision outcome.

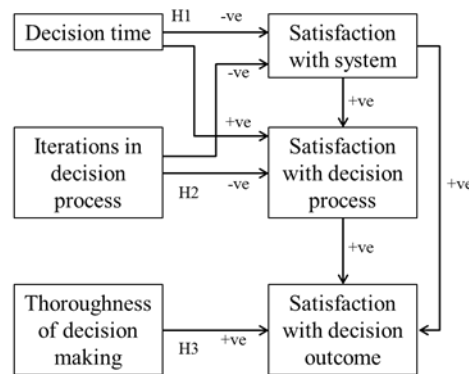


Figure 2. Research Model Based on Hypotheses, adapted from Paul *et al.* (2004)

The goal of this paper is enable the understanding of the decision's quality achieved with an argumentation system and to evaluate its capability to potentiate the decision's quality. Aiming to contemplate different approaches from researchers of a wide range of areas in this thematic (computer sciences, psychology, economy, etc.), a theoretical-based model is presented, seeking to include in the satisfaction analysis all the necessary variables.

The rest of the paper is organized as follows: in the next section is discussed the decision satisfaction thematic and how satisfaction emerges and is related in a decision environment. Section 3 presents the proposed model. Section 4 discusses the relationship between all the points that compose the model and how they measure the participant's satisfaction with the decision. Finally, some conclusions are taken in section 5, along with the work to be done hereafter.

2. DECISION SATISFACTION

The satisfaction with a decision resulting from a decision process is something that needs a complex analysis and involves multiple variables. Obviously the satisfaction is related to what we think a good decision is. But what is a good decision? As previously referred, in the common sense a decision is considered good because of the analogy made with the obtained results.

Assumption 1: Decision satisfaction is related with the decision results.

However, psychologically, the results are not enough to make a participant consider a decision as good. Higgins (2000) says that "psychologically, then, a decision is perceived as good when its expected value or utility of outcomes is judged to be more beneficial than the alternatives."

Assumption 2: Evaluation of each alternative and comparison between them influences satisfaction.

“The costs of attaining the outcomes can also influence whether a decision is perceived as good. The outcome benefits have to be weighed against the costs of attaining the outcomes. The costs include not only the goods or services one must give in exchange for receiving the benefits but also the costs of the decision-making process itself. The decision-making process that would optimize outcomes might not be used because the costs in cognitive effort or time are too high” (Higgins, 2000).

Assumption 3: The process necessary to reach a decision influences satisfaction.

Therefore, it is clear that there is much more than knowing whether the chosen alternative was the participant's favourite in order to evaluate his satisfaction with the decision. It has been suggested that a purely cognitive approach may be inadequate in modelling satisfaction ratings, so it is particularly important to include emotional variables (Liljander and Strandvik, 1997; Oliver *et al.*, 1997; Wirtz and Bateson, 1999). The research that has been made in the field of satisfaction has recognized that there is a need to incorporate the emotional and affective components in regulating consumer's satisfaction (Wirtz *et al.*, 2000).

Assumption 4: Emotional and affective components should be included to understand real satisfaction with the decision.

Therefore, it is not only the final results or the decisions made that determine the quality and the satisfaction of the decision. In his work, Higgins says: “We are all familiar with the idea expressed in the maxim of the late-19th-century British statesman John Morley, “It is not enough to do good; one must do it the right way,” or the coaching classic, “What counts is not whether you win or lose but how you play the game.” Such maxims reflect a moral position: Achievements should be evaluated not only in terms of outcomes but also in terms of the means by which they were attained. “The ends do not justify the means.”” (Higgins, 2000). Using the reasoning present in this approach and the moral objective of these famous maxims, the relevance of the process in performing a certain action is easily understood. We can also conclude that the impact of the decision-making process can drastically change the participant's satisfaction regardless of the results. Higgins also refers that “this insight concerns how the goodness of a decision depends not only on its relation to ends or outcomes but also on whether the means used to make it were suitable. Suitability here refers only to what is morally proper. By considering proper the more general meaning of suitable as “fit”, a new perspective on what makes good decisions good is possible” (Higgins, 2000).

Consciously or not, people create expectations on (almost) everything. The relationship between expectations and the satisfaction is rather obvious. For instance, if someone's life goal is to have a yacht, but the expectations on the possibility to get it are extremely low, the fact of not getting the yacht will never have a notorious negative impact. But if someone has the objective to go on

vacations next year and if the expectations for that to happen are really high, if that does not happen there will be a very strong negative impact. The same happens in opposite situations. According to assimilation theory (Sherif and Hovland, 1961), consumers experience a psychological conflict if they perceive a discrepancy between their expectations and their perception of the consumption experience (Rodríguez del Bosque *et al.*, 2006). Moreover, the nature of the expectation-satisfaction relationship may depend on several contextual and behavioural factors. So, users' expectations may have a different impact on the satisfaction formation within particular contexts. Expectations may even be more important when they are unambiguous (Nyer, 1996), the product performance is ambiguous (Yi, 1993; Oliver, 2010) and/or the consumer is well experienced (Söderlund, 2002).

Assumption 5: Decision makers create expectations. The expectations are created about everything that is undefined or is going to happen (process that leads to a decision and outcomes).

The consideration of several factors is therefore necessary to obtain a correct approach in the satisfaction analysis of a decision-maker regarding the decision made. The studies addressed in this section show the importance of analysing the whole decision-making process, and the whole set of actions that involve and influence the participant during the process. We also verified that it is necessary to analyse a set of emotional factors in that process, and that emotional changes mean situations that affect the participant. It is obvious that this brings new challenges, such as to better know the participant to better understand the impact of each situation in each kind of person. Considering the assumptions deduced from the knowledge found in literature, next are presented the premises that need to be validated by a decision satisfaction analysis model to be complete.

Premise 1: When expectations are exceeded the final satisfaction will be positively affected.

- The expectations analysis is fundamental to assess final satisfaction. The fact that the final outcome is more positive than what was expected will result in a higher final satisfaction. It is considered that the larger is the expectation difference to the expected outcome the more positively affected will be the final satisfaction.

Premise 2: When the expectation is maximum and the result is the expected, expectations do not influence satisfaction.

- The fact that the uncertainty level for a given outcome is absolute, i.e., the participant considers the probability for a given event to occur as certain (100% belief), causes the expectation to have a neutral impact on satisfaction when he reaches that objective.

Premise 3: Expectations have a greater impact on events that are considered most important.

- The most important events are positively or negatively affected with a greater intensity by expectations because, due to their relevance, important events include other factors, such as: stress, anxiety, etc.

Premise 4: When the expectations are not reached, final satisfaction will be negatively affected.

- The fact that we do not reach what we expect will negatively influence the final satisfaction. It is the opposite situation of Premise 1.

Premise 5: When there are no expectations and the final outcome is not as expected, expectations do not affect satisfaction.

- This is the opposite situation of Premise 2. The fact that certain objectives are not reached but at the same time there is not any (zero) expectation of reaching them causes expectations to not negatively influence satisfaction.

Premise 6: A positive emotional cost positively affects the final satisfaction.

- The emotional cost is positive when the set of emotions generated throughout the process allows the participant to reach the end with a more positive mood than the one he started the process with. In this case the emotional cost contributed to the final satisfaction to be greater.

Premise 7: A negative emotional cost negatively affects the final satisfaction.

- When the emotional cost is negative it means that the final state of humor more negative than the initial state of humor. The emotions generated throughout the process are responsible for the change of this state of humor. In this case the emotional cost contributed to the final satisfaction to be lesser.

Premise 8: A neutral emotional cost will not affect final satisfaction.

- When the emotional cost is neutral the final satisfaction is not affected. This means that there was no emotional cost. The difference between the positive and negative emotions allowed to maintain a state of humor or spirit equal to the initial.

Premise 9: The adopted strategy affects satisfaction.

- The strategy can be considered as a strategic plan or action performed taking into account the agent or participant's personality. The way the agent or participant acts influences satisfaction to the extent that his actions define his interactions throughout the process.

3. PROPOSED MODEL

In this section, we explain the proposed model and how all the points of the model are connected. Furthermore, while we are explaining the model we do the bridge between the points of the model and the assumptions defined before.

Knowing the importance of the process in the satisfaction analysis, all the analysis that purely stress the analysis of the results fall down. In addition, to study the process we cannot focus only on a cognitive approach. Bailey and Pearson (1983) agreed that satisfaction in a given situation is the sum of one's feelings or attitudes toward a variety of factors affecting that situation. By creating this model

we tried to find the points that can help measure satisfaction without the need to use the final questionnaires the participants usually have to answer. Our goal is to manipulate certain data, which at the end allows the system itself to evaluate the status of the participants' satisfaction with the decision. Therefore, to analyse the participants' satisfaction with the decision it is important to consider the chosen alternative, his expectations related to the decision and to the process, his personality, and his emotional changes.

A. Point 1 – Satisfaction concerning the chosen alternative

According to the literature the perception of the decisions' quality is related to the advantages that the participant identifies in that alternative, comparing it against the others. Thus, whereas the preferred alternative is the best in the participants' perspective, the distance between the preferred alternative and the chosen one means a loss of the participants' satisfaction regarding the decision. The loss of satisfaction comprises the difference in the assessment made by the participant for each of the alternatives, as well as what the participant did not achieve with the final decision.

There are five different scenarios that may occur in a meeting, affecting the satisfaction differently:

1. The alternative chosen by the decision-makers is the one chosen as the preferred by the participant. At this point, his satisfaction is related to the assessment he makes on this alternative (Do not forget that it may be the preferred one and not being in anyway the alternative he finds brilliant. The preferred alternative may be one that was not even an option to choose from);
2. The participant starts the meeting with a preference of an alternative, he does not change his opinion during the process, but at the end the chosen alternative will always be one he never took into consideration;
3. The participant may start the meeting with a preference on an alternative and later switch to another one. However, the alternative chosen by the decision-makers ends up being the one he initially chose;
4. The participant may start the meeting with a preference on an alternative and later switch it to another one that eventually will be chosen;
5. The participant starts the meeting with a preference on an alternative, he changes his mind during the process, but at the end the chosen alternative will always be one that he never took into consideration.

This first point of the model intends to satisfy the argument presented in assumption number 2. The usual approach in this situation is taking only into consideration the evaluation done by the participant (decision maker) to the alternative chosen by the group, but as we could verify in the literature this isn't enough. The idea of this point is to understand the satisfaction in terms of alternatives evaluation but also to contemplate a little bit of the assumption number 3. First, it is important the participant evaluates all the alternatives so we can "evaluate each alternative and compare them" (assumption 2), second, it is also very important to understand in what terms the evaluation occurred (assumption 3).

B. Point 2 – Participants' expectations according to the decision and process

As we verified in assumption 5 is important to know the participants' expectations according to some issues, in order to have a more accurate perception of the satisfaction, so we think it is important to study the participants' expectations on the following topics:

1. Complexity of the meeting: The participant should be questioned about how he thinks the meeting will be held, in order to reflect on whether he thinks it will have many conflicts and if the understanding among the participants will be problematic. And so, the following question can be asked: "Will this meeting be problematic?";
2. Probability of the participant's preferred alternative to be chosen: Understanding the expectations regarding the probability of the participant's preferred alternative to be chosen. "How likely you think your preferred alternative will be chosen?".

These two topics are the ones we consider most relevant for analysing the expectations due to the impact the process and the results have on the participant, as previously stated. Besides that, these two topics are easier for the participant to classify regarding its expectations.

There are three different types of impact on satisfaction for each suggested topic:

1. Positive Impact: When the final results exceed the expectations;
2. Negative Impact: When the expectations are higher than the results achieved;
3. Without Impact: When the expectations are achieved.

C. Point 3 – Factor concerning the personality

The personality is a concept that cannot be briefly defined, because it has a different meaning according to some psychologists who study it. Although most of them would agree that the field of personality is the study of how individuals differ from each other, psychologists would differ about the best way to conceptualize these types of differences (Santos *et al.*, 2011). The fact that people differ in their ideas and attitudes, makes them react differently to the factors they are exposed to. Recently, satisfaction is being studied regarding the most different scenarios according to the persons' personality. For instance, Schimmack *et al.* (2004) conducted a study on two factors of The Big Five that contribute to life satisfaction: the Neuroticism and the Extraversion. Another study was conducted by (Judge *et al.*, 2002), where they tried to establish a correlation between the values of each type of personality of The Big Five and Job satisfaction.

Knowing that the personality of each one of us influences satisfaction, we think it is relevant to take into account the personality on our analytical model of satisfaction. At this point, we can't do any kind of considerations on how each personality type lives the satisfaction in this context. Anyway, this point remains open because we find it relevant. This point also will helps in work better the assumption 4.

D. Point 4 – Emotional changes

Knowing the importance of the decision-making process, and to make conclusions about the participants' satisfaction regarding decision-making, it is necessary to understand what happens during the process. As mentioned before, it is important to include in the satisfaction analysis affective and emotional components (Liljander and Strandvik, 1997; Wirtz and Bateson, 1999; Wirtz *et al.*, 2000).

Having said this, we want to include, at this point, the analysis of generated emotions and to know how they can change the participants' mood. There are two important points to be studied:

1. The sum of emotional spaces that exceed positively or negatively the participant's normal state: it is thus possible to measure the emotional cost that the meeting had on the participant;
2. The participant's mood at the end of the meeting.

4. MEASURE THE RESULT OF THE SATISFACTION USING THE MODEL

To measure the output of each one of the points in the model we must define how they are related. It is considered that the first issue of Point 2 (complexity of the meeting) is strongly related to Point 4 (emotional changes), while the second issue of Point 2 (probability of the participant's preferred alternative to be chosen) is strongly related to Point 1 (satisfaction with the alternative chosen by the group). So the Point 2 (expectations) will not work isolated, but it will influence the results of the other two points.

The expectations will change the values for Point 1 and Point 4 through a particular impact. The impact causes an expectation that is obviously not always the same. Even knowing the impact that causes the expectation is positive, negative or neutral, it is necessary to quantify that impact.

Beyond expectations, Points 3 and 4 will also have an impact on Point 1. This is because it is considered that the satisfaction about something always gets related to the evaluation made (the choice of the service, product, etc.). After this evaluation, there are other factors, such as expectations and the process, that change satisfaction. Thus, in this case, the Point 1 will be the analysis performed by a human being, while the other points, according to the context, will affect or not (positively or negatively) the satisfaction.

To make this clearer, Figure 3 illustrates the impact of each point of the model in the process of measuring satisfaction. At the moment this is a preliminary process that intends to show how everything fits together from a theoretical point of view.

Initially, satisfaction is calculated taking into account the alternative chosen by the group (Point 1) and the emotional changes (Point 4) with the impacts caused by the expectations. After the values of these two points have been recalculated, the final values for each point are obtained for the calculation of satisfaction. Emotional changes, as well as personality, will also have an impact on the participant's satisfaction with the option chosen by the group.

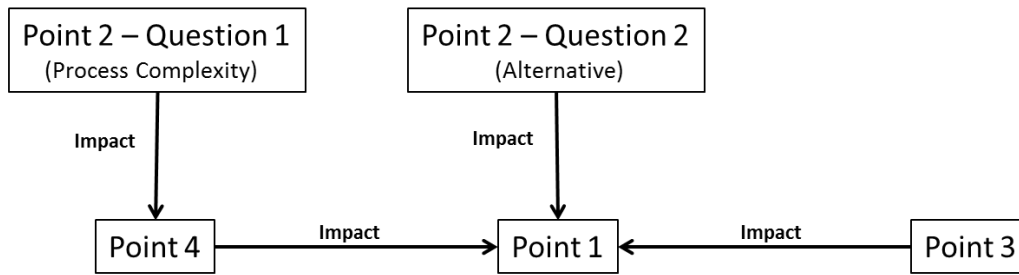


Figure 3. Impact caused by each of the points of the model

The use of the personality in the final calculation may not exist directly. This happens for example when we are dealing with a multi-agent system in which the arguments used by the agents are according to the identified personalities. This will generate emotions and the change of mood regarding the personality. Thus, Point 3 is not covered in the final formula despite being covered by the system indirectly.

The Figure 4 shows how every points fix to each other and how they work together to turn this model possible.

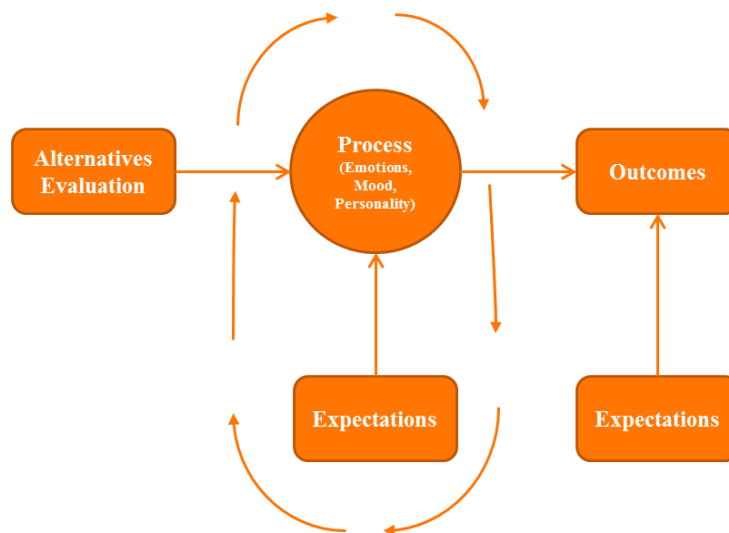


Figure 4. Proposed Model

5. CONCLUSIONS AND FUTURE WORK

Several concepts of satisfaction and the existing models to assess satisfaction were presented. Furthermore, this paper proposed a whole new model which pretends the assessment of the participants' satisfaction in a meeting, supported by a GDSS. We believe that the proposed model allows the attainment of a large amount of useful and valuable information. The points presented in proposed model try to cover every assumption created after reading the literature on different areas (psychology, computer science, economy and sociology). Considering the assumptions deduced from the knowledge found in literature, were presented the premises that need to be validated by a decision satisfaction analysis model to be complete.

This is the first model of satisfaction analysis, which considers every point found as relevant in the literature. This model intends to turn possible to understand how the different automatic negotiation models enhance the decision quality. Through this model it will be possible to evaluate and compare the results between the several models, and maximize satisfaction, i.e., the decision quality, in the future automatic negotiation models, as the most important point in the context of group decision.

As future work, first we will turn this (preliminary) model mathematical and after we will conduct a case study with real people, in partnership with psychologists. With that work, we also intend to make the model assertive by the possible improvements that might result after analysing and studying the collected data.

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