Aiding to Decide. Concepts and Issues.

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1 Introduction

What should I do now? It is sure that you have asked yourself more than once such a question. We all face problem situations in which we need to think before acting. It is also sure that several times it happens that you address such a question to somebody else or that somebody else asks you *what to do now?* It is this precise situation we are interested in: when somebody asks somebody else some help in order to decide (a decision aiding situation). However, we need to be more precise.

First of all we are not interested in any type of decision aiding. Putting aside intuitive and friendly advising activities which occur in our everyday life, we are interested in the professional dimension of such an activity and more specifically when formal tools and languages are adopted, introducing some form of rationality (just to be distinguished from psychotherapists and lawyers, to mention two decision aiding professions who do not use such formal tools and languages). We are interested in the profession of "decision analyst".

Does it always make sense to use such formal tools and languages in order to help somebody deciding? Of course not and we are all aware that both intuitive support as well as other professional approaches can be very useful and successful. However, there are situations where a formal analysis is requested, needed, preferred, imposed and such situations are the ones we are interested in. We are not going to analyse when such situations occur (it is out of the scope of this chapter), but rather focus on what happens when such a demand arises. Why are we focussing on such a subject?

1. Despite the decision analyst profession being almost a century old, there is very little analysis of what makes this profession specific. In other terms it rarely happened that the activities of decision aiding have been the subject of scientific investigation. It seems as if the fact of using rational tools prevents from conducting a rational analysis of this activity. We would like to contribute in filling such a gap.

2. Professions are based on guidelines. Practical guidelines which novice practitioners use in order to fill the lack of experience. Decision Analysis is

surely a craft (see [39]), but is increasingly becoming a profession which needs such guidelines (see for instance the discussion about ethical guidelines in [17]. We try to introduce some basis for such guidelines here.

3. Decision Analysis has been most of the time taught as if the students were going to become on their turn researchers in Decision Analysis. It turns out that most of these students are going to become practitioners. We need to structure our teaching following how decision analytic tools and methodologies are used in practice. We try to contribute in this direction.

The following chapter is basically divided in two large sections. In the first one we analyse the concept of decision aiding process and the cognitive artifacts produced within it. The second section tries to provide some answers to practical questions of the type:
- how to formulate a decision problem?
- what is a problem statement?
- how to structure the information provided by different stakeholders, criteria and scenarios?
- how to choose a decision analytic method?

2 The Decision Aiding Process

Aiding somebody (or a more complex entity such as an organisation, a committee or any other informal setting of actors with some decision power) is a rather complicated issue although addressed routinely in informal and/or professional way. Psychologists, lawyers, family counsellors, priests, friends, the family, consultants, experts, trusted accountants, all qualify as potential advisors for somebody who feels to be in trouble (independently if really she is in trouble) and is asking: "what should I do now?"

Keeping our discussion informal, trying to help somebody involved in some process for which she feels in difficulty in order to decide what to do next, implies aiding her (who asks for advice) and yourself (as an advisor) to understand issues such as:
- what is exactly the problem?
- who else is affected by that problem?
- why is this a problem?
- how "serious" is this problem?
- what resources (including time) do we have?

- what do we know about that problem?
- what is important in that problem as far as who asked the advice is concerned?
- what is possible? feasible? preferable?

The reader will note that some of these questions are not necessarily the ones you may ask yourself if you are in some trouble. For instance you know your values and preferences and you are not going to ask yourself to understand them, while you have to do so if you advise somebody who naturally will have different values. We can thus consider two different settings.

- One where somebody "decides" for herself and we can imagine a sequence of mental activities allowing her (and we thus call her a decision maker) to reach a conclusion: we call such setting a decision process.
- Another where we can imagine a discussion, a sequence of interactions between two entities which we will identify as the "client" (who demands for advice) and the "analyst" (who provides the advice) aiming at aiding the client to go further in some decision process she is involved: we call that a decision aiding process.

There is one critical observation to make at this point. In a decision process we assume that who is involved in that process (individual or collective entity, human or artificial) is going to make a decision. We can thus allow ourselves to call this entity a decision maker. In a decision aiding process we can not make a similar hypothesis. The analyst makes no decisions at all and the client's concern is not necessarily a decision. She might be interested in understanding, in describing, in arguing, in justifying, in discussing, in convincing etc. and the advice she looks for needs to be appropriate for that scope.

Decision processes have been accepted as a subject of scientific investigation in economy, computer science, cognitive sciences, sociology, organisation studies and there is a large literature around this subject (see [4, 5, 13, 15, 22, 25, 28, 32, 33, 34, 35, 49, 51, 52, 53, 55]).

Decision Aiding Processes instead have been very little studied in the literature (if not as reports of real world case studies, but see also [48]). Professional bodies such as lawyers, therapists and councilors have manuals for conducting, assessing and validating such processes in their respective professional areas, but there is nothing similar for decision analysts. Roy in [41] and [42] adopts this term as a different approach in decision analysis, while Brown in [10, 11] follows a more profession oriented analysis of this concept. Bouyssou et al. ([9]) and Tsoukiàs in [54] suggest a different perspective which is discussed here.

The basic idea is that the decision aiding process can be on the one hand a subject of scientific investigation and on the other hand it can be used as a basis in order to help decision analysts in conducting their activities. Under such a perspective a decision aiding process can be seen as a sequence of cognitive artifacts produced through the interactions between the client and the analyst. Such artifacts summarise the information modelled through the process and can be used as a checklist by the analyst while conducting the process itself. The four cognitive artifacts suggested by Tsoukiàs in [54] are the following ones:
- a representation of the problem situation;
- a problem formulation;
- an evaluation model;
- a final recommendation.

The reader will note that not all such artifacts are produced in all decision aiding processes. Aiding somebody to decide could be just help her to understand the problem situation where she is involved or arrive to formulate a decision problem without necessarily elaborating an evaluation model and/or a recommendation. Besides, in real decision aiding processes such artifacts are not constructed linearly. In the following we present more in detail the above mentioned artifacts.

2.1 The problem situation

A representation of the problem situation is the result of an effort aimed at replying to questions of the type:
- who has a problem?
- why is this a problem?
- who decides on this problem?
- what is the commitment of the client on this problem?
- who is going to pay for the consequences of a decision?

The construction of such an artifact allows, on the one hand, the client to better understand his position within the decision process for which she asked the decision support and, on the other hand, the analyst to better understand his role within this decision process.

From a formal point of view a representation of the problem situation is a triplet:

$$\mathcal{P} = \langle \mathcal{A}, \mathcal{O}, \mathcal{S} \rangle$$

where:

- $\mathcal{A}$ is the set of participants to the decision process;
- $\mathcal{O}$ is the set of stakes each participant brings within the decision process;
- $\mathcal{S}$ is the set of resources the participants commit on their stakes and the other participants' stakes.

Such a representation is not fixed once for all within the decision aiding process, but usually will evolve. Actually, one of the reasons for which such a representation is constructed is to help clarify the misunderstandings during the client - analyst interaction and therefore improve the communication between these two actors. It can also turn useful when both the two actors have to establish whether their efforts are legitimated with respect to the decision process.

2.2 The problem formulation

For a given representation of the problem situation the analyst might propose to the client one or more "problem formulations". This is a crucial point of the decision aiding process. The representation of the problem situation has a descriptive (at the best explicative) objective. The construction of the problem formulation introduces what can be called a model of rationality. A problem formulation reduces the reality of the decision process, within which the client is involved, to a formal and abstract problem. The result is that one or more of the client's concerns are transformed into formal problems on which we can apply a method (already existing, adapted from an existing one or created ad-hoc) of the type studied in decision theory.

From a formal point of view a problem formulation is a triplet:

$$\Gamma \quad = \quad \langle \mathbb{A}, V, \Pi \rangle$$

where:
- $\mathbb{A}$: is the set of potential actions the client may undertake within the problem situation as represented in $\mathcal{P}$;
- V: is the set of points of view under which the potential actions are expected to be observed, analysed, evaluated, compared, including different scenarios for the future;
- Π: is the problem statement, the type of application to perform on the set A, an anticipation of what the client expects (the reader can see more details on this point in [2, 36, 43], for a detailed example see [50]).

Obtaining the client's consensus on a problem formulation has, as a consequence, the gain of insight, since instead of having an "ambiguous" description of

the problem we have an abstract and formal problem. Several decision aiding approaches will stop here (for examples see [40]), considering that formulating (and understanding) a problem is sufficient to act upon, thus limiting decision aiding at helping to formulate problems, the solution being a personal issue of the client. Other approaches instead will consider the problem formulation as given (as suggested in many Operational Research and Decision Analysis textbooks, see [58]). Within a constructive approach the problem formulation is one among the artifacts of the decision aiding process, the one used in order to construct the evaluation model.

2.3 The evaluation model

With this term we indicate what the decision aiding models traditionally are, as conceived through any operational research, decision theory or artificial intelligence method. Classic decision theoretic approaches will focus their attention on the construction of this model and consider the problem formulation as given.

An evaluation model is an n-uplet:

$$\mathcal{M} \quad = \quad \langle A, \{D, \mathcal{E}\}, H, \mathcal{U}, \mathcal{R} \rangle$$

where:

- A is the set of alternatives on which the model applies. Formally it establishes the universe of discourse (including the domain) of all relations and functions which are going to be used in order to describe the client's problem.

- D is the set of dimensions (attributes) under which the elements of A are observed, described, measured etc. The set D might be endowed with different structuring properties. Formally D is a set of functions such that each element of A is mapped to a co-domain which we call a "scale".

- $\mathcal{E}$ is the set of scales associated to each element of D. Formally each element of $\mathcal{E}$ is the co-domain of some element within D ($\forall i \ \forall d \in D, \ d_i : A \rightarrow E_i \in \mathcal{E}$).

- H is the set of criteria under which each element of A is evaluated in order to take into account the client's preferences. Formally a criterion is a preference relation, that is a binary relation on A (a subset of $A \times A$) or a function representing the criterion.

- $\mathcal{U}$ is a set of uncertainty structures and/or epistemic states applied on D and/or H. Depending on the language adopted, $\mathcal{U}$ collects all uncertainty distributions or the beliefs expressed by the client which can be associated to the relations and functions applied on A, besides possible scenarios to which uncertainty can be related.

- $\mathcal{R}$ is a set of operators such that the information available on A, through D and H can be synthesised to a more concise evaluation. Formally $\mathcal{R}$ is a set of operators such that it is possible to obtain a global relation and/or function on A, possibly allowing to infer a final recommendation.

The reader can observe that a large part of the existing decision aiding models and methods (see e.g. [6]) can be represented trough the above description (from traditional optimisation procedures to multiple criteria decision making methods and artificial intelligence tools). Besides, such a description allows to draw the attention of the reader to a number of important remarks:
1. It is easy to understand that working with only one or more evaluation dimensions, a single or multiple criteria or that using a combinatorial optimisation algorithm or some other method is the result of some modelling activity where as analysts we convince ourselves and our clients that this is the correct way to proceed. What is important is not to choose the method before the problem has been formulated and the evaluation model constructed, but to show that this is the natural consequence of the decision aiding process as conducted up to that moment.
2. The technical choices (typology of the measurement scales, different preference models, different aggregation operators) are not neutral. Even in the case where the client has been able to formulate his problem clearly and he is convinced about it (possibly using one of the techniques aiding in formulating problems), the choice of a certain technique, procedure, operator can have important consequences which are not discussed at the moment where the problem has been formulated (for a critical discussion see [8]). Characterising such techniques, procedures and operators is therefore crucial since it allows to control their applicability to the problem as has been formulated during the decision aiding process.
3. The evaluation models are subject to validation processes, namely (see [30]):
- conceptual validation (verify the suitability of the concepts used);
- logical validation (verify the logical consistency of the model);
- experimental validation (verify the results using experimental data);
- operational validation (verify the implementation and use of the model in everyday life).

2.4 The final recommendation

The final recommendation represents the return to reality for the decision aiding process. Usually the evaluation model will produce a result, let's call it Φ. The final recommendation should translate such a result from the abstract and formal language in which Φ is formulated to the current language of the client and the decision process in which she is involved. Some elements are very important in constructing this artifact:
- the analyst has to be sure that the model is formally correct;
- the client has to be confident that the model represents her preferences, that she understands it and that she should be able to use its conclusions (the client should feel as the "owner"'of the results, besides being satisfied of them);
- the recommendation should be "legitimated" with respect to the decision process for which the decision aiding has been asked ([29]).

We should pay some attention to this last observation. The decision aiding process is an activity which introduces a certain distance between the participants on the one hand and the reality of the decision process and its organisational dimension on the other hand. Returning back to reality requires to check whether the results are legitimated. We should check whether such results are accepted or not by the participants to the decision process and understand the reasons for their position (such reasons can be completely independent from the decision process itself). Being able to put in practice the final recommendation definitely depends on such legitimation. No legitimation means no implementation.

3 Some Practical Questions

In the following we are going to address a number of practical questions an analyst has to answer while involved in a decision aiding process. We will keep the presentation to a rather informal shape although we are discussing formal concepts

3.1 What is the problem?

The client you are working with does not have a single problem. There are many problems she is facing depending on her activities and her position within a certain organisational context (possibly a context involving multiple organisations). Typically she will be involved in several decision processes. If she asks for some

advice or help that will concern at least one (if not more than one) of such decision processes. There are two "steps" to follow trying to understand "what is the problem".

1. The first step consists in getting an insight of the one or several decision processes in which the client is involved and more precisely the one for which the aid is requested. If there is a problem then there is a process within which the problem appears. A decision process implies other participants who carry on their own concerns and commitments of resources in order to handle such concerns. These need to be understood.

2. The second step consists in understanding why this problem is perceived as such by the client: why is it a problem and why does she need an external advice in order to handle it? Only at that point it is possible to start formulating a decision problem to work with. *Establishing a production plan is a problem for your client's organisation because actually they need a production plan, but it becomes a problem for you as analyst because your client does not know how to handle the combinatorial explosion of all possible single production actions that are presently used.*

Not all decision aiding activities end stating a formal decision problem. A frank discussion with the client or a post-it session with a group of clients can be sufficient and much more effective than many mathematical or formal exercises. However, there are cases where we need to go further than simply understanding the problem situation and we have to formulate a formal decision problem. In doing so we need to establish three types of information.

1. On what are we deciding? A formal decision problem needs to fix a set of objects on which to apply a decision procedure. The question is: how is this set constructed? It could be an enumeration of objects. It could result from combining "portfolios" of single actions or options, thus obtaining complex sequences, plans or actions. It could result from combining the values of different attributes or continuous decision variables. We call such a set "alternatives". Where does this information come from? Certainly we need to ask the client, however, the analysis of the problem situation should be the starting point. Typically some of the client's concerns can be translated in terms of potential decisions and thus in potential actions. Then it should be understood if such actions can stand alone (thus obtaining an enumeration of objects) or if they have to be combined among them.

Moreover it should be understood whether such actions could be described under different points of view.

2. What do we know or should we know about the alternatives? There are three different potential sources of information and/or knowledge to be considered. First, different descriptive dimensions (attributes) of the alternatives. Then different opinions of relevant stakeholders involved in the decision process. Finally different scenarios and/or states of the world under which the problem could evolve. We call all these different assessment dimensions "points of view". Where does this information come from? Some of the client's concerns can be the source of such points of view. At the same time the analysis of the resources committed (or requested) by the client in order to handle the decision problem can be a hint in order to construct such a set of points of view.

3. How the client's problem translates in terms of formal decision problem? Since we work with formal models we need at a certain point to establish a formal decision problem: in other terms we need to establish how the set of alternatives is going to be manipulated in order to obtain something which could be considered useful for the client as far as her problem is concerned. We call that a "problem statement".

3.2 What is a problem statement?

At this point we already have a set of potential alternatives. The problem is what are we going to do with such a set? From a formal point of view we need to establish how the client's decision problem will become an application on the set of potential alternatives.

It is easy to observe that we can take different "decisions". Consider a set of alternatives being candidates (persons). We may be looking for *THE* candidate (to recruit for some position) or to rank the candidates from the worst to best or to classify them in good, acceptable and unacceptable candidates or even to separate them in the ones fitting a scientific scholarship from the ones fitting a humanities scholarship. Several times the concept of "deciding" is associated to the one of "choosing", but this is rather limited with respect to the large variety of problem situations in which our clients happen to be. We need a more broad concept of "decision problem" in order to be able to take into account such different situations.

Technically speaking we can generalise the concept of decision problem as an "appropriate partitioning" of the set of alternatives (see [12]). In other terms a "decision" results in constructing a set of equivalence classes of alternatives having some desirable properties. Going back to the candidates example if we are looking for *THE* candidate this implies partitioning the alternatives in two classes: the choice element and all the others. Instead if we are ranking the candidates we are constructing a number of equivalence classes (unknown; maximum as much as the candidates) to be ranked from the worst to the best.

There are two possible ways to characterise the partitioning of the set of alternatives.

1. The first concerns the possibility to have ordered classes (on one or more dimensions) or not.

2. The second concerns the use of external information (with respect to the set of alternatives) in order to define the classes or not; in other terms whether the classes are defined using information about the alternatives only or are pre-established with respect to some external source of information (profiles, standards, references etc.).

Combining these two partitioning characteristics we obtain the four basic problem statements which we claim cover all possible formal decision problems:]] - ranking (ordered equivalence classes not predefined);
- rating (ordered predefined equivalence classes);
- clustering (unordered equivalence classes not predefined);
- assigning (unordered predefined equivalence classes).
There are two special cases for all the above problem statements:
- the case where the equivalence classes are only two, one being the complement of the other;
- the case where the cardinality of one or more equivalence classes is fixed.

Example 3.1 *Let's go back to the candidate's case.*
- Ordering the candidates from the best to the worst is a ranking problem statement. The specific case where only two classes are requested, the first being as small as possible will be called a choice problem statement.
- Separating the candidates to the ones to be accepted with no further inquiry, from the ones to be rejected with no further inquiry, from the ones to be further interviewed respecting the school's standards is a rating problem statement.

- Grouping the candidates in similar anatomic characteristics is a clustering problem statement.
- Identifying the candidates fitting the scientific scholarships programme as well as the ones fitting the humanities scholarships programme is an assigning problem statement.

How do we choose a problem statement? Of course it depends on what the client specifies as her problem. Usually decision makers understand the difference between the problem statements and are able to provide reasonable information about it. On the other hand this is a typical case where the trial and error approach works fine. An unappropriate problem statement will immediately generate information the client will realise being useless. The problem statement will be refined through feedback.

3.3 Stakeholders, Criteria, Uncertainties.

As already mentioned in section 3.1 we generally assume the existence of three different types of information concerning the alternatives:
- the opinions and judgements that relevant stakeholders (including the client) have about these objects (or parts of them);
- features of the alternatives on several different attributes;
- possible scenarios and states of the nature under which the information concerning the alternatives may be different.

The raw information comes under sentences of the type:
- stakeholder α likes alternative x;
- stakeholders α and β prefer x to y;
- the client does not like z especially if combined with w;
- the opinion of stakeholder α counts more than the opinion of stakeholder β;
- the value of x on attribute a_1 is k;
- the value of y on attribute a_2 is more or less m;
- the value of z on attribute a_3 is $\langle linguistic\_variable \rangle$ (such as fat, young, intelligent, not better specified);
- attributes a_1 and a_2 are more important than attributes a_3 and a_4;
- under scenario n_1 alternative x is unacceptable;
- under scenario n_2 alternative y is better than alternative z;
- scenario n_1 is more likely to occur than scenario n_2;
- etc.

From a formal point of view opinions, attributes and scenarios are all different dimensions on which we assess the alternatives. We can summarise the possible information under three types of sentences:
- alternative x on dimension d_j is k (k being more or less precise and/or well defined);
- alternative x is before (after, very near) alternative y on dimension d_j (ordering information);
- dimension(s) d_j is "more important" than dimension(s) d_i;
- as well as all possible combinations and conditional sentences that can be constructed (such as *"stakeholders α and β have a positive opinion about x on attribute a_1 and a negative one on attribute a_2, but only under scenario n_1; in case of scenario n_2 then opinions split in opposite directions"*).

The issue is what do we do with such information. What we really need in order to elaborate some recommendation for the client is to transform all that in terms of preferences (and/or constraints), possibly in an homogeneous way which should allow us to elaborate them and return something of the type: "taking into account the information and your preferences the winner is ...". There are three steps to undertake in order to do so.

1. First we need to understand if all this information really matters for the client. Does the opinion of a certain stakeholder or the value of an attribute matter for the client's decision? A typical way to check that, is to consider hypothetic alternatives which are identical, but for one dimension and then ask the client if this difference would be sufficient to take a decision. If yes, then this dimension some way matters, if not, then it is irrelevant.

2. Then we need to transform all relevant information in some homogeneous preferential information. The first basic step here is to obtain for each single dimension an ordering relation reflecting the client's preferences and values. *If x is red and y is yellow we need to know than the client prefers red things to yellow things. If a certain stakeholder considers differently two alternatives we need to know how this concerns the client's preferences. And so on.* The second basic step is to check whether it is possible to associate to such an ordering relation some more rich information in terms of "distances": *if x is before y which is before z on a certain dimension, can we tell something about the distance between x and y and between y and z? Can we compare such distances?* The third basic step is to understand whether the orderings on each dimension (possibly the more rich ones) can be compared to orderings on other dimensions: *if x is better than y on dimension d_1 can we*

compare this preference with the preference of y against x obtained on dimensions d_2 and d_3? If we know the distance between x and y on dimension d_1 can this be compared to the distance of z and w on dimension d_2?

3. The last step consists in checking dependencies among the preferential statements of the client. *The typical example in this case is the situation where if we order at the restaurant meat we prefer red wine to white wine, but if we order fish we prefer white wine to red wine.* If such conditional statements exist and if preferential independence does not occur then we need to take that into account on how to proceed further when we will have to manipulate this information in order to obtain the final recommendation.

How do we obtain such information? There is abundant literature on this subject (see [7, 14, 20, 21, 23, 24, 26, 27, 45, 46, 47, 57]). Basically there are three possible approaches in order to do so:
- direct protocols (see [56]);
- undirect protocols (see [3, 44];
- learning from examples (see [16, 18].

A final remark the reader should consider is the following. There is always a certain distance between the intuitive way the client expresses her preferential information and the formal way in which this is considered within a model. The client is not necessarily aware of the formal consequences a certain statement has: *when she claims that a certain dimension is more important than another one she implicitly assumes that these two dimensions have comparable preference orderings and if she tries to quantify such an importance she implicitly establishes a quantitative way to compare such orderings. However, if we submit to her such consequences it is not sure that she will agree. It is extremely important to be very clear on such aspects of the modelling process*.

3.4 How to choose a method?

The problem of choosing an appropriate method in order to elaborate the preferential information obtained from the client is an old one and already studied in the literature (see [1, 19, 37, 38]). In the following we are going to adopt an approach introduced in [37] based on the idea that the choice of a method should allow to reinforce the arguments under which the recommendation suggested can be accepted by the client and be legitimated within her decision process, besides being formally correct.

In order to understand how the process works we need to fix which are the "primitives" on which our model is based. With such a term we intend the elementary information which cannot be derived from other preferential information. Our starting point thus are the preferential sentences the client uses in order to communicate her values and constraints.

Recent literature ([9, 31]) suggests that such primitives are only the comparisons among alternatives either on single attributes or on bundles of attributes. With that in mind we are now ready to suggest the main guidelines under which classify the methods (and thus choose them).

1. A first major distinction, obtained from establishing the appropriate problem statement) is whether the comparisons among alternatives express preferences (asymmetric comparisons) or similarities (symmetric comparisons). Ordering problem statements (such as rating and ranking) are based on preferences, while not ordering problem statements (such as clustering and assigning) are based on similarities. There are of course special cases where asymmetric relations are used in order to make similarity comparisons, but the basic idea remains the distinction previously introduced.

2. A second major distinction, obtained from elaborating the preferential statements of the client, concerns how the preferences on each single dimension and among the different dimensions should be considered. As already mentioned in section 3.3 we need to know whether the preferences expressed on each dimension are purely ordinal or not (the distances among the alternatives are considered or not) and how such preferences compare among the different dimensions. At this point we should pay attention to the fact that often among the preferential statements provided by the client we get sentences concerning the "importance" of the different attributes. Although this is useful information it should be noted that this is not a primitive information and should be double checked using the comparison of vectors of values of the attributes in order to validate such statements. Further on we need to establish any dependencies among the preferences expressed on the different dimensions.

3. A third major distinction concerns the possibility to use explicitly "negative preferential statements" which should be considered independently from the "positive ones". The idea here is that there are cases where the client needs to express negative judgements and values which are not complementary to the positive ones (such as a veto on a specific dimension). Under the

perspective where the model elaborated is expected to be used in order to construct the arguments for which a certain recommendation is acceptable it might be important to have a clear distinction between the positive arguments supporting the recommendation and the negative ones against it.

The above three dimensions cover practically the whole area of possible methods that can be used in a decision aiding process.

4 Conclusions

What do we have at the end of the day? Let's try to summarise the important issues we discussed in this chapter.

There are situations where it is requested to provide decision support using formal tools and languages. We defined the activities occurring in such a setting as a decision aiding process. This can be scientifically investigated, analysed, decomposed and represented under the form of checklists, practical guidelines and teaching modules. We do not want to reduce the importance of the craft dimension of aiding somebody to decide, but focus on the potential of structuring this type of activities.

There is no single way to state a decision problem and this is extremely important when we try to construct a formal model of our client's problem situation. We have introduced a simple classification of formal problem statements which we claim covers the whole range of methods and tools used in our profession.

Despite decision aiding being a rather complex process, a thorough analysis of the formal structures used in order to provide some advice reveals that we use few, simple and relatively easy to manipulate tools: ordered structures and sets, elementary measuring principles and basic epistemic concepts about beliefs and uncertainties are sufficient along with the algorithmic aspects of the methods adopted. Of course these combine in more complex objects (the decision analysis protocols and methods), but the elementary bricks are simple.

Where do we go from here? This is just a small introduction on how the complex knowledge about decision aiding using formal tools and languages can be structured. Hopefully further investigation, analysis of real world experiences and discussion will provide deeper insight about this exciting profession.

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