Critiquing with Multiple Criteria: Conflict Detection and Resolution

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Building a taxonomy of conflicts is difficult. At smaller grain sizes, the types of conflicts are as diverse as the specific domains in which they occur. At larger grain sizes, the types of conflict are as diverse as the theories of conflict detection and management. This diversity should not be surprising. Conflicts reflect the differing approaches that individuals have to common problems, and the approaches of the individuals are shaped by their specific areas of expertise. Our approach accepts this sort of diversity, but attempts to structure the process of conflict recognition and management through the notions of parameter values and criteria that do not always demand complete satisfaction in a rigidly defined system of criteria. Our approach focuses on the "fuzziness" of reasoning about planning and decision making, and the construction of critiques based on degrees of satisfaction. It should be noted the account of "fuzziness" that we use is not the same as that given in standard fuzzy logic. Rather our focus is on the degree to which less than precise and exact parameter values can be appraised by less than precise and exact criteria. The system is currently being developed in the field of composite materials design and manufacturing.

Identification of conflicts

It is often difficult to identify a conflict in a planning or decision making process. Each local expert concentrates on her or his field of expertise. This localization allows the individual to build or resolve in isolation from the effects of the construction or resolution on other individuals in the process. If a strict rational bureaucratic approach to cooperative distributed activities were successful, all conflicts would be resolved before local experts set to work on the pieces of the problem. This seems highly unrealistic, since it would require that the problem decomposition be perfect. More realistically, problem decomposition is partial and sketchy, and is subject to criticism from below. This suggests that the approach to conflict detection and management should not be viewed as a rigorous system of hierarchical constraint propagation, but as a process in which numerous criteria and parameter values are melded into a plan or decision.

The melding of parameter values and criteria into a decision is a process in which diverse participants in the process alter either their parameter values or criteria to build a consensus decision. A conflict occurs when the parameter values and criteria do not produce an acceptable level of satisfaction. Note that the acceptable level of satisfaction is not only a function of some thresholding function, but is also a function of the role that is played by the criteria in the appraisal of the parameter values. Some criteria may have a very privileged status so that they must be satisfied if consensus is to be reached, other criteria may have varying levels of satisfaction, but within their group they must on the whole provide a reasonable level of satisfaction, and finally some criteria may indicate things that are desirable or undesirable and modify the more basic evaluation.

The social dimension adds the notion that the parameter values and criteria represent diverse perspectives on the task at hand. These diverse perspectives represent various areas of expertise. However, each area of expertise has a similar structure of parameters and criteria. Conflicts can occur either when the parameter values within an area do not produce an acceptable satisfaction level for the criteria, or when the parameter values do not produce an acceptable level of satisfaction for some other set of criteria. It should be remembered that the acceptable level of satisfaction is a function of all of the relevant parameter values and criteria. Thus, it is possible that some aspect of the planning or decision making have a low satisfaction level, while the overall satisfaction level is acceptable.

Conflict management

By viewing the conflict identification process in terms of many parameter values and criteria, and allowing that these items need not have crisp values, it is possible to indicate a variety of ways in which the overall satisfaction can be improved and a consensus solution formed.

The simplest case is that in which the value of a parameter can be altered. Typically there will be many such parameters that might be altered so as to improve the overall level of satisfaction. Since the values and criteria are imprecise or inexact, this is an attractive option. It may be the case that slight changes in the parameter values, can lead to acceptable results. A more complicated case occurs when there is a need to alter the criteria. This can occur in two distinct ways. The first way is to change the relative importance of a criterion. It might be that altering the status of a criterion may resolve the conflict. The second option is that the actual criterion be altered.

Discrete and continuous values

Classically one of the ways in which conflicts have been resolved has been an appeal to logic. The core idea has been that if two individuals share the same information and the same logical techniques, then they will come to the same conclusion. A conflict would exist just in case they either did not share the same information or if they did not share the same techniques. Aristotelian, Boolean, and Russelian logics attempted to construct the set of "correct" techniques and limit conflict to different bodies of information. These efforts relied on the notion of a bivalued calculus in which every proposition was either true or false and never both. There are, however, deviations from this view. There has been an historically evolving interest in multivalued or multivalent calculi [1, 2]. Some have held to three valued systems of truth, falsehood, and indeterminacy, or presence, absence, and ambiguity. In the early 1930's, Jan Lukasiewics, formally developed a three valued logical system. This system expanded the bivalent framework to a system that allowed three logical values [0, 1/2, 1], and subsequently into any value contained within [0 ... 1] [2]. By the late 1930's, Max Black [3] extended this concept to include the application of continuous logic values to sets or lists of symbols. Described by Black as "vagueness," each element in Black's multivalued sets and lists behaved as a statement in continuous logic. Lofti Zadeh, built on the previous work by Black and others. He introduced the term "fuzzy" to the scientific community. Fuzzy logic as defined by Zadeh in the mid-1960's concentrated on the membership of an individual in a solution set, more generally called the fuzzy set, of the problem domain [4]. While the problem domain and the individuals are well defined, the degree to which the individual may or may not belong the fuzzy set is ambiguous. The concept of membership (or characteristic) function associates with each individual a grade of membership in the fuzzy set. Typically the grade is based on the unit interval; however, the grade could be based on any numeric interval. Thus, the nearer the grade to the upper limit of the grade interval, the higher the grade membership of the individual in the fuzzy set. This history can be interpreted as one in which there is an effort to extend techniques so as to capture the notion that some conflicts are not simply the result of differing sets of information. Rather, the method allows for either discrete or continuous values of particular propositions. These differing values can allow for the representation of some notion of conflict. If the value of the proposition is not a designated value, then a conflict can exist.

Multiple parameters and criteria

The Displaced Ideal

While an ideal solution is desirable, it is often unobtainable or unfeasible. However, the ideal solution is approachable. The Displaced Ideal technique utilizes a desired optimal solution for each parameter as a goal. The various alternatives of the parameter or functional sets are compared to this optimal solution. A new "feasible" goal is then calculated.

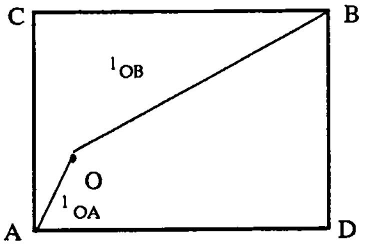
In the Displaced Ideal technique the possible solution set or alternative solution set must be known. For domains with a large number of parameters with wide variations in the possible values, the alternative set becomes large and unwieldly. Parameters that can be randomly distributed within a region are especially difficult to handle. Pruning techniques are useful in assisting in this combinatorial explosion of alternatives. However, this usually requires the introduction of some type of control system into the decision process.

The best results utilizing the Displaced Ideal technique occur when there are a limited number of "relevant" parameters. This does not mean that the problem domain must be extremely limited, but that the number of parameters that directly effect the selection of a "best" obtainable solution is small. By conducting the search for a Displaced Ideal on the subspace defined by these relevant parameters, a solution can be more easily found, and the distance measure more accurately describes how far away the displaced solution is from the ideal solution.

Sets-as-points and Fuzzy Entropy

In the mid 1980's, the concepts of sets-as-points and fuzzy entropy [5] were developed. The idea of sets-as-points centers around the idea that each parameter can be represented as a one dimensional component of a nth dimensional hyper plane. The fuzzy set of parameter mappings represent a vector in this hyper plane. The composite measure of the set can then be found by calculating the cardinality of the set.

Fuzzy entropy is the measure of "How fuzzy is a fuzzy set?" Entropy measures the uncertainty of a system. Its uncertainty is its fuzziness. In the sets-as-points view, the mapping range for the fuzzy set represents a hyper cube within the hyper plane defined by the parameters. The fuzzy entropy is calculated by comparing the distance measure of the fuzzy set point to the nearest and farthest vertex. It varies from 0 to 1 throughout the hyper cube. Shown graphically in a two dimensional space, point O is located a distance l_{OA} from fuzzy set A, and a distance l_{OB} from point B.



Limitations of Existing Methods

Analysis techniques can be considered as search algorithms that determine an acceptable solution from the global set of possible solutions. This search for a solution is conducted as described earlier by each of the various techniques. While each technique is applicable to various problem domains, limitations exist that necessitate the development of more flexible approaches.

Iterative or replacement techniques such as Multiattribute Utility Theory (MAUT) and the Displaced Ideal work well in situations where certain parameters are determined to have a greater influence on the overall decision process than do the other remaining parameters. Also these techniques are geared toward domains of fixed quantities. This requirement is acceptable for continuous range problems only when variations within the domain range is either estimated or predictable. For the general case this does not necessarily hold true. Parameters often can fall seemingly arbitrarily within a range, but are not adjustable quantities. For example, a parameter of an object can be described as having a value between some upper and lower limit. While the constraining boundaries do place limits on the value of the parameter, the exact value may or in many cases may not be assumed. It is when the exact value of the parameter cannot be reasonably assumed that problems arise since trade-offs between parameters or parameter utility is necessary to obtain a solution. Unfortunately for many problems the exact value of the parameters are not known.

Rule based systems are the most flexible of the solution techniques. These systems range from simple "If... then..." statements to agenda driven systems of antecedent pattern matching. The most popular development environments (CLIPS, G2, KEE, ART, etc.) all utilize a form of agenda control to manage when a so-called rule is executed and how the response effects the overall system. These systems are generally very flexible, but often difficult to design and to verify and validate. In most cases, systems designed in this manner expect either exact parameters or evaluate ranged parameters on their boundaries for comparison to conditional statements. Allowing a parameter to have a value that is finite, but may arbitrarily fall within a certain range is difficult to handle with traditional approaches.

Fuzzy Logic is an attempt to address the problem with variations in parameters or consequences. Fuzzy Logic can be considered as a more specialized form of expert system technology. As previously described, fuzzy sets are generated which define the degree to which a certain event is likely to occur. Again this set is usually considered as a finite set of mappings of likelihood's to possible occurrences. The fuzzy entropy then becomes a measure of how likely the event will occur based on known or "certain" parameter-event relationships. This technique is applicable to a large number of problem domains where input parameters have a wide range of possibilities. However, techniques that involve continuous domains, mapping functions, and consequences are not easily handled by this technique directly.

There exists a large number of problem domains and solution spaces that are characterized by degrees of uncertainty in the parameter input values and the partial satisfaction of constraining relationships. As humans, we deal with these types of problems on a daily basis. Since none of the above techniques are designed to address this type of problem domain, a new technique must be developed that can analyze situations involving parameters with bounded domain ranges that may partially satisfy constraint equations that themselves have variations in acceptability. A technique that could perform this type of analysis would greatly increase the ability of automated systems to quickly arrive at possible solutions that may have otherwise required much more intensive analysis with more conventional techniques.

The Conformal Metric Aggregation (CMA) technique utilizes various portions of the concepts that have been presented above. There are, however, several subtle differences in the problem domain addressed by this approach and the domains represented in the preceding techniques. These differences require the development of a new and flexible technique. The differences between the techniques will be examined and in subsequent sections a detailed presentation of this new hybrid technique will be given.

Differences Regarding the Approach

Although our approach is similar to many other multi-metric approaches to conflict resolution, there are several differences. [6-11]

First, CMA assumes a final solution and then analyzes the parameters based on rules or metrics to critique this selection. What is the task or mission of a critiquing system? The answer is found in the definition. A critique is a critical analysis or review. Therefore, a critiquing system should evaluate a given set of parameters for performance acceptability within the problem domain. It is not an optimization, nor is it necessarily interested in determining alternative solutions to the problems. This is a fundamental difference in a technique that is designed to assist in finding a solution and a system whose goal is to evaluate a prospective solution. However, by propagating through the prospective solution choices, a pseudo-optimal solution can be determined.

The parameter domains differ. These differences are two-fold. First, realistic problems deal with various classes of relations (or metrics). These relations can be quantitative, qualitative, Boolean, and conditional. The term "conditional metric" here refers to metrics that rely on the presence of certain criteria before it is analyzed. For example, suppose there was a metric relating to the minimum radius of a hole that is located in a part. If there is no hole in the part, then this metric does not apply to the problem at hand; however, if there is a hole, it would apply. As the complexity of the problem increases, so too do the combinations of these various classes of metrics. The overall effect of each type of metric, as well as the effect of each individual metric, must be maintained. The technique presented here attempts to address these requirements by the use of three types of evaluations. They are discussed in detail in the section on metric classes later in this presentation.

A second way in which the numeric parameters differ is in the mappings. In the preceding solution techniques the fuzzy sets generated were based on mappings of parameters with a finite number of values and a finite number of mappings. How does this mapping differ with the more generalized problem addressed by CMA in which the parameter domain and the mapping function varies independently across a continuous region? Since the technique is now dealing with a continuous interval of possible parameter values and a continuous interval of mapping functions, integration across this interval is necessary. The exact integral form used is discussed in the metric evaluation discussion that follows.

Finally, parameter inter-dependencies need to be maintained. In realistic problems, parameters are not independent entities that can vary in value without having some effect on other associated parameters. CMA addresses this issue directly maintaining these inter-dependencies as will be shown in the following section.

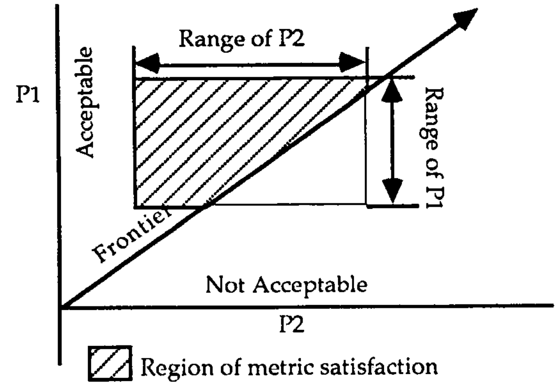
System description

A typical problem engaged in many fields of endeavor is the appraisal of a product or process either proposed or currently existing in terms of multiple criteria of varying levels of importance and varying levels of satisfaction. The system generates such appraisals, which we call critiques, that both evaluate and makes suggestions. The system is implemented as a "shell" with domain for composites manufacturing.

The Composite Design and Manufacturing Critiquing System (CDMCS) that is currently under development is based on several principles. (1) The system ought to supply the user with a critique of submitted material. (2) The system should allow that the user submitted material may contain strengths and weaknesses as well as failures to conform to various criteria. (3) The criteria used in the critique may vary in terms of both the aspect being appraised and the importance of the particular appraisal. Although several software efforts have targeted the domain of composites, this system is being built to aid designers in evaluating the incorporation of composite materials into their designs. [12-19] The current focal point of the system is on process selection, but the system is being designed to incorporate other components of process planning. The system also incorporates the idea that in the design and decision making phase of projects concerning relatively new technology, both the parameter values and the evaluation criteria (metrics) are spread or inexact. The parameter values and criteria are spread or inexact in the sense that there are ranges of values that can lead to the satisfaction of a criterion and that those ranges tend to decay away from a clear central point. For example, one might allow that a particular process is acceptable in the range of 100 to 10,000 units, but 5,000 units is a good target number. This might be further qualified by noting that the acceptability of the process falls off quickly as one moves further from the target number. This represents the expert's knowledge of the system. On the other hand, the end user might know that the expected production range is from 3,000 to 6,000 units. There are, of course, other criteria and parameter values to take into account. Although the system under development aggregates the various degrees of satisfaction of the various criteria, the aggregate value is only taken as a global indicator. The system is designed to provide the user with an account of the strengths and weaknesses of the relation between his or her parameter values and the criteria and make specific suggestions concerning how the aggregate value can be improved by indicating which parameter values can be changed and how they can be changed to bring them more in line with a target case. In brief, The CDMCS takes an inexact multi-metric approach to the critique of process plan decisions and provides the user with an explanatory account of the strengths and weaknesses of his or her proposal, as well as hints on the data areas that should be examined more closely and the types of changes that would lead the proposal to be more in line with the expert's knowledge of the target values for the process.[20 -22]

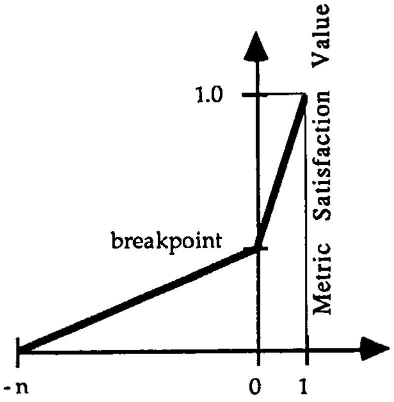
Our approach stresses that: (1) the user of the system is knowledgeable about the domain, (2) there are diverse criteria that can be applied to any decision, (3) the criteria can be grouped in terms of their importance for a decision, (4) the values for parameters are only approximately known, (5) the evaluation of the "goodness" of any proposal is a function of the collection of criteria and approximately known parameter values, (6) the critique generated by the system should both explain the appraisal of the parameters in terms of the criteria and should offer suggestions to improve the overall "goodness" of the proposal, and diminish the level of conflict.

Graphical Depiction of Metric Satisfaction



The basic components of the system are simple. There are parameters and criteria. The criteria are applied to the parameters and a degree of satisfaction obtained. The degree of satisfaction for all criteria is then aggregated. What distinguishes our approach from the "weights and normalization" approach is that we allow for degrees of importance in the criteria, ranges of values in the specifications of parameters and criteria, and various types of decay from a central point for those ranges. Additionally, the system uses a breakpoint strategy for aggregation that differs from simple threshholding by "penalizing" a low satisfaction of one metric in terms of its contribution to the overall evaluation.

Graphical Representation of Fuzzy Function



Fuzzy Function Results

Parameters are the basic items that are appraised. Parameters are either Boolean, qualitative, or quantitative (continuous) and can be characterized in terms of ranges about a focal point. The decline of the value from the focal point can also be described as uniform, linear, or logarithmic. There is a set of tools for editing and inserting parameters.

Criteria are classified as requisite, core, and enabling. The requisite criteria are those that must be satisfied if the parameter being appraised is to "pass." Core criteria are those criteria that must be satisfied collectively to some degree if the parameter being appraised is to "pass." Enabling criteria add to or subtract from the basic satisfaction in terms of requisite and core criteria. The collective evaluation of all of these criteria is the evaluation of the product or process. Additionally, conditional criteria are supported that allow for branching to particular sets of criteria with or without carrying forward the satisfaction level that led to the branch point. The system provides tools for defining these criteria.

An environment is a collection of parameters and criteria that are used in a critique. In an environment the user is allowed to modify the importance of a criterion graphically through a 'drag and drop' gesture. This allows the user to not only modify the parameter values to get better results, but also the criteria. This feature can be very important when one is a planning stage or when one wants to examine the effect of either a new criterion or a change of criterion classification on already existing parameter sets.

The critiques are presented at two levels of detail in both text and graphical form. Text explanation of the appraisals are automatically generated. A mechanism for accepting suggestions and revaluation is provided.

Support for both text and graphic information is available in terms of both viewing and editing as hypertext-like subsystems. This is important since it may allow the end user to better understand the parameters and other descriptive elements, and thus avoid misunderstandings and potential conflicts. The system is implemented in Macintosh™ Common LISP. Improvements that are currently under way include tools for capturing the intent of a critique, case-based reasoning comparisons, and network communications support.

Evaluation of multiple criteria

The evaluation of multiple criteria presents two problems. First under what conditions is a criterion evaluated and how is the criterion satisfaction affected by these conditions? Secondly, what does the statistical satisfaction of an individual criterion mean to the overall evaluation of the multiple criterion problem? The investigation of these two questions led to the development of a novel approach to multiple criterion analysis.

Criteria often have antecedent clauses which must be satisfied before the consequence of the criterion is evaluated. For Boolean parametric relations, this is generally straight forward. The antecedent is either satisfied or it is not. However, for numerical relations the antecedent relation may only be partially satisfied. The degree to which an individual numerical criterion is satisfied is determined through the spatial integral of the parameter space and criterion space overlap as shown in the following expression:

$$P_{Satisfaction} = \oint_S \Phi(p_1,\ldots,p_n) * \mathrm{M}(p_1,\ldots,p_n)\, ds$$

where Φ is the probability density function for the parameter space defined by the parameters $p_1, \ldots p_n$ and M is the criterion distribution function for the criterion space defined by the parametric relations for $p_1, \ldots, p_n$.

One method for determining whether the antecedent is sufficiently satisfied to proceed with the evaluation of the consequence is to use a minimum threshold value for the antecedent satisfaction, S_{ante}, as a flag. Depending on the type of criterion being examined, the user can specify that the statistical satisfaction value of the consequence of the criterion, P_{cons}, be modified to reflect the degree of satisfaction of the antecedent. This modification is in the following form:

$$P_{Satisfaction} = 1 - (1 - S_{ante}) * (1 - S_{cons}).$$

For the case of a single antecedent clause this is straightforward. But if a criterion has multiple antecedents, what is the collectively measure of the overall antecedent satisfaction? It can be observed that the analysis of the antecedent closely mirrors the evaluation of multiple criteria. In fact, if the antecedent clauses are considered to be criteria, then the cases are the same. This leads again to the second consideration.

How should these criteria be collectively analyzed? Probability theory itself has limitations in that, unless weight factors are introduced, the multiplicative nature of the partial satisfactions can quickly cause the composite probability to approach values which would indicate non-satisfaction. Certainty factor analysis, likewise, distorts the overall view of the collective results of the individual criteria. Standard fuzzy logic approaches involve using a membership function to assign "degrees of likelihood" to events to form a so-called "fuzzy set." These sets represent individual mappings of specific events. However, this too must be modified for continuous parameters and criterion intervals.

A new and different aggregation algorithm is needed to better represent the collective effects of the criterion group. One such algorithm uses a two-step procedure to create a composite rating for the criterion set. The algorithm uses a break-point strategy to create an intermediate representation of how each individual criterion effects the collective group, and the overall satisfaction for the criterion set is determined by summing these intermediate values as below:

$$S_{ante} \text{ or } S_{Metric\ Group} = \Sigma F(P_{Satisfaction_i})$$

where F is a function that determines the intermediate satisfaction for the individual criterion satisfaction.

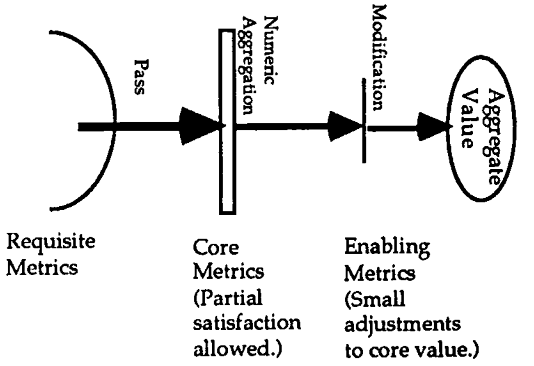
Qualitative representations can also be determined by mapping the composite satisfaction to a range representing each of the qualitative responses. Criterion antecedent satisfaction values can be handled in a similar manner.

Effects of the various criterion types

The system allows for three main criterion types: requisite, core, and enabling criteria. Each of these criterion types have a different responsibility in the overall analysis scheme. Requisite criteria are those criteria that are rigidly required for process success. These criteria are generally Boolean in nature, but can be numeric criteria which require total satisfaction. If any of these criteria are not completely satisfied, then the process is deemed unsatisfactory. Requisite criteria are processed before the other metric classes, but failure does not prevent the core and enabling criteria from being evaluated. However, no degree of satisfaction of the core and enabling criteria can reverse a failure of the requisite criteria.

Core and enabling criteria are generally numeric or qualitative in nature. They are analyzed in a similar manner, but the individual criterion satisfaction values are aggregated differently. The core criteria are criteria that have strong importance to the critiquing process. Therefore, it is vital that these criteria be satisfied to at least a high degree in order to produce a high degree of satisfaction in the proposed process selection. The individual criterion intermediate values assume values from 1 to -n where n is the number of core criteria evaluated. This results in a failure or near failure of a single core criterion to cause the overall failure of the combined criterion group analysis.

<u>Metric Aggregation</u>



Enabling criteria are those criteria which are not required for the success of a particular process selection, but slightly influence the degree of satisfaction. These criteria are aggregated in a manner such that their intermediate aggregation value falls in the range -d to d where d is a reasonably small percentage value. The overall aggregation value therefore can only be influenced by all of the enabling criteria by ±d. A typical value of d is 0.2.

$$\text{Aggr} = \frac{1}{n}\sum_{i=1}^{n} f_i^{\text{Core}}(S_i) + \frac{1}{m}\sum_{i=1}^{n} f_i^{\text{Enabling}}(S_i)$$

Extending to multiple participants

In many cases it may not be possible to have all of the individuals engaged in decision making available at the same time to make decisions about plans and schedules. The system provides a partial remedy for this problem. Since the criteria can be partitioned different sets of criteria can be used as surrogate representatives of the individuals who have the authority to make decisions. This would permit an individual to propose changes and receive feedback on what the criticisms of the proposed change would be from different points of view. This would allow individuals to use the available tools to test various changes and anticipate criticisms before the time where commitment decisions are made. We believe that this is a significant advantage to our approach and would increase both the effectiveness and efficiency of the planning process.

Technique Similarities

Obviously there are numerous differences between the CMA technique and those presented in the introductory sections of this presentation. However, there are several similarities and analogies that can be made with this technique. The displaced ideal technique is searching for a non-optimal occurrence that best matches the optimal. Again CMA is not an optimization approach, but an evaluation. The CMA technique is evaluating a proposed location for acceptability. If successful, the CMA candidate solution (which itself is most probably non-ideal) would be a candidate solution for an optimization technique such as the displaced ideal.

The multi-attribute utility technique is utilizing the ideas of bounded ranges in order to arrive at a solution. While CMA does not utilize the concept of parameter utility, it does evaluate the parameter values across bounded ranges of metrics.

In a general sense, the aggregate solution is also a form of distance measure between the proposed and ideal solution. This is analogous to the distance measures utilized in the displaced ideal and the sets-as-points technique, or the cardinality of a fuzzy set in the sets-as-points technique when the vector space is one dimensional.

The CMA technique is unique. Its approach to analyzing the problem is similar in some regards to various classical approaches, but very different in others. The domain class of interest itself and the critiquing task are the primary causes for the necessity of these differences. While CMA is no more a panacea solution for problems involving fuzzy or uncertain information and criterion than any other technique, it does work well for a number of this domain class problems.

Conclusion

While it is difficult to provide an accurate and useful taxonomy of conflicts, it is possible to use a general account of conflict in terms of parameter values and goals to build a useful system for the detection, management, and, perhaps, avoidance of conflicts. Conflicts occur as a result of the interactions of parameter values and criteria. The system that we have developed provides a flexible approach to the recognition and management of conflicts. By allowing for inexact parameter values and criteria, as well as various levels of importance for criteria, it is possible to make smaller adjustments that can lead to a satisfactory overall level of "goodness." Since each collection of criteria expresses a viewpoint of some domain expert, it is possible for the individual to receive "surrogate" criticisms from the collection of criteria created by another individual. The available of such "surrogates" allows the expert to see beyond her or his domain expertise, and, perhaps, avoid needless conflicts.

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