Group Decision Making With Explicit MultiAttribute Evaluation

Cardinal Approach

- The committee members may have:
  - Agreed set of Attributes
  - Individual Sets of Attributes

The Recreation Complex Problem

- Five committee members, who are experts, have been charged with the evaluation and selection of the possible places where the new recreation complex may be built
- Eleven basic attributes were finally agreed upon by the five committee members.

Recreation Complex Example

- The committee members also agreed on the use of the scale (very low, low, average, high, very high) to evaluate x_1, x_2, x_4, x_5,x_6,x_{10},x_{11}
- They also agreed on using the scale from 0-10 to evaluate the criteria of x_3, x_7, x_8 and x_9

Recreation Complex Example

- They classified the attributes into two categories:
- Benefit attributes: x_1, x_2, x_3, x_7, x_8 , x_9, x_{10} and
- Cost atributes: x_4, x_5 , x_6 and x_{11}

- Each of the five members on the committee prepares a rating for each of the nine places

- (See the the A^k matrices in the distributed sheets where k represents the experts, k= 1..5)

Steps of the Cardinal Approach: (Agreed Attributes)

- Step 1: For each decision maker k, normalize the individual decision values in order to get the individual normalized decision matrix D^k(Use vector normalization, i.e., the elements of Dk will be calculated as:)

$$d_{ij}^k = x_{ij} / (\sum x_{ij}^2)^{1/2}, \quad i=1..m, \; j=1,..,n$$

(see the D^k matrices in the distributed sheets, k= 1..5)

Steps of the Cardinal Approach: (Agreed Attributes)

- ✔ Step 2:Judgement aggregation

Simple average of rating value under each criteria

For each criterion, we have the collective matrix, C, which is based on the aggregation of all the committee members. Then

$C = [c_{ij}] = (\sum_k d_{ij}^{k}) / n$

(n is the number of experts and is equal to 5 in the recreation complex problem)

- ✔ (See the C matrix in the distributed sheets)

Steps of the Cardinal Approach: (Agreed Attributes)

- Step 3:Attribute weighting
- Since all the attributes may or may not be of equal importance, the committee agrees on **attribute weights** (w_j), $\sum_j$ **wj=1**
- Use Delphi or Nominal Group Technique to find the weights).
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Steps of the Cardinal Approach: (Agreed Attributes)

- Step 3:Attribute weighting(continues)
- Therefore, the weighted normalized collective matrix F is,

$$F = [f_{ij}] = [c_{ij} w_j]$$

where i= Alternatives(1…m) and j=attributes(1..p)

(in the recreation complex problem the the relative importance for each of the eleven basic criteria is regarded equally by all the committee membersTherefore the matrix F is the same as matric C)

Steps of the Cardinal Approach: (Agreed Attributes)

Step 4: Use the TOPSIS method(see the corresponding slides)

The collective preference ordering is found

For the recreation complex problem, when TOPSIS is used for the matrix F, the relative closeness of the alternatives to the ideal solution are as follows:

C_1=.649, C_2=.490, C_3=.482, C_4=.427, C_5=.496, C_6=.429, C_7=.470, C_8=.548, C_9=.520

Steps of the Cardinal Approach: (Agreed Attributes)

Step 5: Ranking the collective preference orderings according to the descending value of C_i

For the recreation complex problem:

$a_1, a_8, a_9, a_5, a_2, a_3, a_7, a_6, a_4$

✔ Step 6.Recommendation submission

(After further discussion and/or revision)

The recommendation is submitted to the top manager

Steps of the Cardinal Approach: (Individual Set of Attributes)

- Step 1:Each committee member may have his/her own attribute set which may or may not be the same as the other committee members
- In that case each committee member has his/her own individual weighted normalized matrix.
- $F^k = [\ f^k_{ij}\ ] = [\ w^k_j\ d^k_{ij}\ ]$

Steps of the Cardinal Approach: (Individual Set of Attributes)

- Step 2:
- TOPSIS can be used to find the individual preference ordering (see the slides of TOPSIS)

Steps of the Cardinal Approach: (Individual Set of Attributes)

- Step 2: (continues)
- In the recreation complex problem, according to the procedure of TOPSIS, the preference ordering is :

For expert 1: a8, a1, a9, a7, a4, a6, a3, a2, a5

For expert 2: a8, a6, a3, a7, a2, a5, a1, a4, a9

For expert 3: a1, a3, a5, a9, a8, a2, a6, a4, a7

For expert 4: a5, a1, a9, a2, a7, a4, a6, a8, a3

For expert 5: a2, a4, a1, a5, a8, a6, a9, a7, a3

Steps of the Cardinal Approach: (Individual Set of Attributes)

- Step 3: Borda's function (or any suitable social choice function) can be used to find the collective (social) preference orderings.
- For the recreation complex problem the Borda scores can be calculated as :

$f_B(a1)= 30$, $f_B(a2) = 21$, $f_B(a3) =15$,

$f_B(a4) =16$, $f_B(a5)= 22$, $f_B(a6) = 17$,

$f_B(a7) = 15$, $f_B(a8)= 25$, $f_B(a9) = 19$. Therefore the group decision is

$a_1 \, P \, a_8 P \, a_2 \, I \, a_5 \, P \, a_9 \, P \, a_6 \, P \, a_4 \, P \, a3 \, I \, a_7$

Information Systems Approach:GDSS

- Recently, information systems technology has increasingly attracted MCDM researchers to implement their MCDM.
- An effective GDSS often possess the following characteristics:
  - emphasis on semistructured and ill-structured decisions
  - Support and improvement of decision making
  - Ability to serve multiple users
  - Support of all phases of the decision making
  - Ease of use

Why GDSS?

- The sophistication of the game theoretic approach-as well as its restrictive assumptions-has discouraged the average decision maker
- Discussions on the theory of elections and social choice seems to suggest a pragmatic avenue to group problem solving
  - Ordinal and cardinal rankings remain basic elements for determining collective choice
  - However, defining collective norms that are specific to a particular context has become a requisite for a satisfactory use of group decision techniques

Primary Roles of the GDSS

- To monitor and coordinate the relationships among the participants either by promoting communication to reconcile differences or by limiting unnecessary or emotional interaction

Literature on DSS

- Eom, S.B., Lee, SM, Kim, EB, Somarajan, C.(1998), “A Survey of Decision Support System Applications”, Journal of Operations Research Society, 49- 109-120
- A Brief History of Deicison Support Systems (http://dss.cba.uni.edu/dss/dsshistory.html)
- Decision Support Ssytems Glossary (http://dssresources.com/glossary/dssglossar1999.
- html)
- Types of DSS:
- Communication Driven DSS Resources((http://dssresources.com/dsstypes/cdss.html)
- Data Driven DSS Ressources (http://dssresources.com/dsstpes/ddss.htm)l
- Model -Driven DSS Resources: http://dssresources.com/dsstypes/mdddss.html

Articles for GDSS

- Pervan, G.P. and Douglas J. Atkinson(1995), “GDSS Research: An Overview and Historical Analyze”, Group Decision and Negotiation, Vol.4, N.6, November, pp.475-485
- Vreede,G.J., Wijk, W.V.(1997), “A Field Study into the Organizational Applicability of Group Support Systems”, in Proceedings of ACMC Conference, San Francisco, April 1997
- Heril, H.W. and Vreede,G.J.(2000), “Experiences with Facilitating Policy Meetings with Group Support Systems”, accepted to be published in International Journal of Technology Management)
- Reeves, G.R. and Bordetski, A.(1995), A framework for Interactive Multicriteria Group Deicison Support”, Group Decision and Negotiation, Vol. 4, N.2, March 1995.

Articles for GDSS

- Munemori,J., Nagasawa,y.(1996), “GUNGEN: Groupware for a new idea generation support system”, Information and Software Technology, 38, pp.213-220.
- Briggs, R.O. and Vreede,G.J.(1997), “Meetings of the Future: Enhancing Group Collaboration with Grou Support Systems”, Creativity and Innovation Management, vol.6, N.2, pp.106-116

WEB Pages for GDSS

- Group Ware Central (http:./cba.uga.edu/grıupware/groupware.html
- The Group Ware Yellow Pages (http://www.consensus.com/groupware)
- Use of Internet to Implement Support for Distributed Decision Making (http://is.lse.ac.uk/iswnet/pub/iftp8396.htm

Characteristics of GDSS Literature

- Literature of GDSS is more concerned with the facilitation of group meeting than the use of a multicriteria framework

Techniques of Aggregation of Preferences for Group Decision Support (Content Oriented Approaches)

- **<u>The reasons of having more than one group decision technique</u>**:
  - None of the techniques of aggregation of preferences currently known in the literature can satisfy all five conditions imposed by Arrow's Impossibility Theorem
  - Combination of various techniques can increase the chances of reaching a consensus, or can at least constitute a richer basis for bargaining sand negotiation

Examples of GDSS

- For Idea Generation and Problem Structuring
  - DECISION EXPLORER(will be deomonstrated)
  - or Implicit Evaluation
  - JUDGES
  - NAI
- For Explicit Evaluation
  - TeamEC(will be demonstrated)
  - ARGOS I
  - ARGOS II