Group Decision Support Systems for Current Times
Overcoming the challenges of dispersed group decision-making

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Outline

Introduction

Goal

Developed Work
- Hypotheses
- Methods
- Results

Conclusions

Future Work
Decision-making
What was the decision making process that led to hiring a cat?
Disadvantages
- Process losses
- Social loafing
- Groupthink
- Take longer

Advantages
- Benefit from the experiences and perspectives of a larger number of individuals
- Creativity and effectivity
- More enjoyable for members
- If the group is diverse, better decisions may be made
Decide on:

- A city to open a new subsidiary
- A product to invest
- A car brand/model to renew the company's fleet
Web-based/Ubiquitous Group Decision Support Systems
• Resistance to change
• Complexity
• Fear of losing face-to-face dialogue during the meeting
• The lack of human-interaction
• Low ability to represent the decision-makers’ intentions
• Usability issues
• Evaluation
• Information analysis or intelligent reports
What do we have to do to make Web-based GDSS succeed?
To create mechanisms to support disperse groups in the group decision-making process, taking advantage of the benefits inherent to face-to-face scenarios.
Hypotheses

Computer agents can act according to the style of behavior with which they are defined.

It is possible to predict the decision-makers’ perception of the decision quality.

An argumentation-based dialogue model is capable of improving the intelligence (of the agents or entities) and not only to reason about a solution.
Introduction

Goal

Developed Work

Conclusions

Future Work

UbiGDSS/Web-based GDSS (Environment)

- Decision-makers’ Representation
- Decision Satisfaction
- Argumentation-based Dialogue Model
- Other Intelligent Strategies

02/11/2020

Group Decision Support Systems for Current Times - Overcoming the challenges of dispersed group decision-making
Usability
Representativeness
Communication
Intelligent Strategies
Introduction

Goal

Developed Work

Conclusions

Future Work

UbiGDSS/Web-based GDSS (Environment)

- Decision-makers' Representation
- Decision Satisfaction
- Argumentation-based Dialogue Model
- Other Intelligent Strategies

API GATEWAY

- REST API

Analytics Service

Reporting Service

Decision-Making Service

Agents Service

Database

Decision Database

02/11/2020

Group Decision Support Systems for Current Times - Overcoming the challenges of dispersed group decision-making
Group Decision Support Systems for Current Times - Overcoming the challenges of dispersed group decision-making
Introduction

Goal

Developed Work

Conclusions

Future Work

UbiGDSS/Web-based GDSS (Environment)

Decision-makers' Representation

Decision Satisfaction

Argumentation-based Dialogue Model

Other Intelligent Strategies

Introduction

Goal

Developed Work

Conclusions

Future Work

UbiGDSS/Web-based GDSS (Environment)

Decision-makers' Representation

Decision Satisfaction

Argumentation-based Dialogue Model

Other Intelligent Strategies

Introduction

Goal

Developed Work

Conclusions

Future Work

UbiGDSS/Web-based GDSS (Environment)

Decision-makers' Representation

Decision Satisfaction

Argumentation-based Dialogue Model

Other Intelligent Strategies

Introduction

Goal

Developed Work

Conclusions

Future Work

UbiGDSS/Web-based GDSS (Environment)

Decision-makers' Representation

Decision Satisfaction

Argumentation-based Dialogue Model

Other Intelligent Strategies

Introduction

Goal

Developed Work

Conclusions

Future Work

UbiGDSS/Web-based GDSS (Environment)

Decision-makers' Representation

Decision Satisfaction

Argumentation-based Dialogue Model

Other Intelligent Strategies

Introduction

Goal

Developed Work

Conclusions

Future Work

UbiGDSS/Web-based GDSS (Environment)

Decision-makers' Representation

Decision Satisfaction

Argumentation-based Dialogue Model

Other Intelligent Strategies
Introduction

Goal

Developed Work

Conclusions

Future Work

UbiGDSS/Web-based GDSS (Environment)

Decision-makers' Representation

Decision Satisfaction

Argumentation-based Dialogue Model

Other Intelligent Strategies

Developed Work

DM 1

P. Agent 1

DM 2

P. Agent 2

DM 3

P. Agent 3
Introduction

Goal

Developed Work

Conclusions

Future Work

Decision-makers' Representation

- UbiGDSS/Web-based GDSS (Environment)
- Decision-makers' Representation
- Decision Satisfaction
- Argumentation-based Dialogue Model
- Other Intelligent Strategies

Developed Work

- Dominating
- Obliging
- Avoiding
- Compromising
- Integrating

Conclusion

Future Work
Group Decision Support Systems for Current Times - Overcoming the challenges of dispersed group decision-making

Decision-makers’ Representation

- Concern for Self (CS)
- Concern for Others (CO)
- Resistance to Change (RC)
- Activity Level (AL)

Decision Satisfaction

- Dominating
- Obliging
- Avoiding
- Compromising
- Integrating

UbiGDSS/Web-based GDSS (Environment)

Other Intelligent Strategies

Argumentation-based Dialogue Model

Introduction

Goal

Developed Work

Conclusions

Future Work

Dominating(CS, CO, RC, AL)
Obliging(CS, CO, RC, AL)
Avoiding(CS, CO, RC, AL)
Compromising(CS, CO, RC, AL)
Integrating(CS, CO, RC, AL)
Behavior Style | Concern for self | Concern for others | Resistance to change | Activity level
---|---|---|---|---
Dominating | 9.47 | 1.71 | 9.16 | 9.37
Obliging | 1.97 | 8.73 | 1.24 | 2.28
Avoiding | 1.08 | 0.9 | 0.96 | 0.52
Compromising | 5.48 | 6.16 | 4.16 | 5.84
Integrating | 7.77 | 8.46 | 5.43 | 9.0

Dominating(9.47, 1.71, 9.16, 9.37)
Obliging(1.97, 8.73, 1.24, 2.28)
Avoiding(1.08, 0.9, 0.96, 0.52)
Compromising(5.48, 6.16, 4.16, 5.84)
Integrating(7.77, 8.46, 5.43, 9.0)
Decision Satisfaction
UbiGDSS/Web-based GDSS (Environment)

Decision-makers' Representation

Argumentation-based Dialogue Model

Other Intelligent Strategies

Decision Satisfaction

Outcomes

Expectations

Intentions (Style of Behavior)

Emotional Changes and Mood Variation
Outcomes

\[ D_{\text{Lost}} = Alt_F - Alt_P \]
\[ A_{\text{Conversion}} = 2Alt_F - 1 \]
\[ D_{\text{Outcomes}} = (1 - |A_{\text{Conversion}}|) \times D_{\text{Lost}} + A_{\text{Conversion}} \]
Outcomes

Classify each one of the Alternatives according to your Preferences (0 - Not Preferred at all; 1 - Extremely Preferred)

<table>
<thead>
<tr>
<th>Brand</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brand_A1p</td>
<td>0.86</td>
</tr>
<tr>
<td>Brand_B2er</td>
<td>0.68</td>
</tr>
<tr>
<td>Brand_C3fr</td>
<td>0.10</td>
</tr>
<tr>
<td>Brand_D4t</td>
<td>0.25</td>
</tr>
</tbody>
</table>

\[
D_{\text{Lost}} = Alt_F - Alt_P
\]

\[
A_{\text{Conversion}} = 2Alt_F - 1
\]

\[
D_{\text{Outcomes}} = (1 - |A_{\text{Conversion}|}) \ast D_{\text{Lost}} + A_{\text{Conversion}}
\]
Outcomes

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<td>0.25</td>
</tr>
</tbody>
</table>

\[
D_{Lost} = Alt_F - Alt_P
\]

\[
A_{Conversion} = 2Alt_F - 1
\]

\[
D_{Outcomes} = (1 - |A_{Conversion}|) \times D_{Lost} + A_{Conversion}
\]
Expecteds

\[ P_{\text{Impact}} = (1 - E) \times Alt_P \]
\[ D_{\text{Outcomes}} = D_{\text{Outcomes}} + (1 - |D_{\text{Outcomes}}|) \times P_{\text{Impact}} \]
\[ N_{\text{Impact}} = (Alt_P - Alt_F) \times E \]
\[ D_{\text{Outcomes}} = D_{\text{Outcomes}} + \left((1 - |D_{\text{Outcomes}}|) \times (-1)\right) \times N_{\text{Impact}} \]
Expectations

How likely do you think your preferred alternative will be chosen by the group? Value: 0.10

Decision Satisfaction

- Decision-makers' Representation
- Argumentation-based Dialogue Model
- Other Intelligent Strategies

UbIGDSS/Web-based GDSS (Environment)
Expectations

\[ P_{\text{Impact}} = (1 - E) \times \text{Alt}_p \]

\[ D_{\text{Outcomes}} = D_{\text{Outcomes}} + (1 - |D_{\text{Outcomes}}|) \times P_{\text{Impact}} \]
Overview of the content shown in the document:

**Introduction**
- Introduction to the topic

**Goal**
- Outlining the objective

**Developed Work**
- Expectations
  - Decision-makers' Representation
  - Argumentation-based Dialogue Model
  - Other Intelligent Strategies
- Equations:
  \[N_{\text{Impact}} = (Alt_P - Alt_F) \times E\]
  \[D_{\text{Outcomes}} = D_{\text{Outcomes}} + ((1 - |D_{\text{Outcomes}}|) \times (-1)) \times N_{\text{Impact}}\]

**Conclusions**
- Summary of findings

**Future Work**
- Future directions

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On 02/11/2020, the document is titled: Group Decision Support Systems for Current Times - Overcoming the challenges of dispersed group decision-making.
## Intentions (Style of Behavior)

<table>
<thead>
<tr>
<th>Event</th>
<th>CO</th>
<th>CS</th>
<th>Emotions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant’s preferred alternative was chosen by the group</td>
<td>✗</td>
<td>✓</td>
<td>Joy</td>
</tr>
<tr>
<td>Participant’s preferred alternative was not chosen by the group</td>
<td>✗</td>
<td>✓</td>
<td>Distress</td>
</tr>
<tr>
<td>Participant changed his preference to another alternative</td>
<td>✗</td>
<td>✓</td>
<td>Hope</td>
</tr>
<tr>
<td>The majority prefers the participant’s preferred alternative</td>
<td>✗</td>
<td>✓</td>
<td>Joy and hope</td>
</tr>
<tr>
<td>A few or none decision-maker prefers the participant’s preferred alternative</td>
<td>✗</td>
<td>✓</td>
<td>Distress and fear</td>
</tr>
<tr>
<td>The preferred alternative of the decision-maker/s that the participant considers credible/important was chosen by the group</td>
<td>✓</td>
<td>✗</td>
<td>Happy-for, joy</td>
</tr>
<tr>
<td>The preferred alternative of the decision-maker/s that the participant considers credible/important was not chosen by the group</td>
<td>✓</td>
<td>✗</td>
<td>Pity, distress</td>
</tr>
<tr>
<td>The majority prefers the same alternative as some other decision-maker/s that the participant considers credible/important</td>
<td>✓</td>
<td>✗</td>
<td>Happy-for, joy and hope</td>
</tr>
<tr>
<td>The majority do not prefer the same alternative as some other decision-maker/s that the participant considers credible/important</td>
<td>✓</td>
<td>✗</td>
<td>Pity, distress and fear</td>
</tr>
</tbody>
</table>
Emotional Changes and Mood Variation

\[ P_{\text{Expectations}} = N_P / N_t \]

\[ \text{Norm}_{\text{ConsEmotions}} = \text{ConsEmotions} / (\text{PosEmotions} + \text{ConsEmotions}) \]

\[ \text{Emo}_S = \{(P_1, A_1, D_1), \ldots, (P_n, A_n, D_n)\} \]

\[ \text{Emo}_T = \sum_{i=1}^{n} (P_i, A_i, D_i) \]

\[ \text{Int}_{\text{Emo}_T} = \frac{\sqrt{(P)^2 + (A)^2 + (D)^2}}{\sqrt{3}} \]

\[ \text{Exp}_{\text{Int}_{\text{Emo}_T}} = \text{Int}_{\text{Emo}_T} * P_{\text{Expectations}} \]

\[ \text{PosEmotions} = \sum_{i=1}^{n} (\text{Exp}_{\text{Int}_{\text{Emo}_Ti}}) \]

\[ \text{ConsEmotions} = \sum_{i=1}^{n} (\text{Exp}_{\text{Int}_{\text{Emo}_Ti}}) \]

\[ \text{Norm}_{\text{PosEmotions}} = \text{PosEmotions} / (\text{PosEmotions} + \text{ConsEmotions}) \]

\[ \text{Cost} = \text{Norm}_{\text{PosEmotions}} - \text{Norm}_{\text{ConsEmotions}} \]
Scale of Satisfaction

<table>
<thead>
<tr>
<th>Designation</th>
<th>Interval</th>
</tr>
</thead>
<tbody>
<tr>
<td>Extremely Satisfied</td>
<td>[0.75; 1]</td>
</tr>
<tr>
<td>Much Satisfaction</td>
<td>[0,5; 0.75]</td>
</tr>
<tr>
<td>Satisfaction</td>
<td>[0,25; 0,5]</td>
</tr>
<tr>
<td>Some Satisfaction</td>
<td>[0; 0,25]</td>
</tr>
<tr>
<td>Some Dissatisfaction</td>
<td>[-0,25; 0]</td>
</tr>
<tr>
<td>Dissatisfied</td>
<td>[-0,5; -0,25]</td>
</tr>
<tr>
<td>Very Dissatisfied</td>
<td>[-0,75; -0,5]</td>
</tr>
<tr>
<td>Extremely Dissatisfied</td>
<td>[-1; -0,75]</td>
</tr>
</tbody>
</table>

\[ Satisfaction = D_{Outcomes} + (1 - |D_{Outcomes}|) * Cost \]
Introduction  Goal  Developed Work  Conclusions  Future Work

UbiGDSS/Web-based GDSS (Environment)

Decision Satisfaction

Decision-makers' Representation

Argumentation-based Dialogue Model

Other Intelligent Strategies

Decision Support Systems for Current Times - Overcoming the challenges of dispersed group decision-making

Decision-makers’ Representation

Argumentation-based Dialogue Model

Other Intelligent Strategies

Impact of the Process in the Final Satisfaction

Satisfaction obtained in each scenario (by each Style of Behavior)

Expectations with Positive Impact

Expectations with Negative Impact

Emotional Cost

UbiGDSS/Web-based GDSS (Environment)
Group Decision Support Systems for Current Times - Overcoming the challenges of dispersed group decision-making

Introduction

Goal

Developed Work

Conclusions

Future Work

UbiGDSS/Web-based GDSS (Environment)

Decision-makers' Representation

Decision Satisfaction

Other Intelligent Strategies

Argumentation-based Dialogue Model

DM 1

DM 2

DM 3

P. Agent 1

P. Agent 2

P. Agent 3

DM 1

DM 2

DM 3

P. Agent 1

P. Agent 2

P. Agent 3
Group Decision Support Systems for Current Times - Overcoming the challenges of dispersed group decision-making

**Introduction**

Goal

**Developed Work**

Conclusions

Future Work

**Message**

- **Locution**
- **Argument**

[Diagram showing interaction between DM 1, DM 2, DM 3, P. Agent 1, P. Agent 2, P. Agent 3]
**Message**

- **Locution** (Statement, Question, Request)
- **Argument**

**Argumentation-based Dialogue Model**

- Decision-makers' Representation
- Decision Satisfaction
- Other Intelligent Strategies

**UbiGDSS/Web-based GDSS (Environment)**

**Introduction**

**Goal**

**Developed Work**

**Conclusions**

**Future Work**
Facilitator: The Meeting is going to start...

(Public Conversation)
Agent 4: I prefer the Alternative Brand_B2er.
Agent 1: I disagree.
Agent 3: I disagree.
Agent 2: I disagree.

(Private Conversation)
Agent 3 → Agent 4: Will you accept Alternative Brand_A1p?
Agent 4 → Agent 3: I refuse.

(Public Conversation)
Agent 3: Which criteria do you consider as most important?
Agent 2: For me the most important criterion is: Price
Agent 1: For me the most important criterion is: Consumption.
Agent 4: For me the most important criterion is: Consumption.
Agent 3: For me the most important criteria are: Price and Consumption.

...
Argumentation-based Dialogue Model

UbiGDSS/Web-based GDSS (Environment)

Introduction

Goal

Developed Work

Conclusions

Future Work

Decision-makers’ Representation

Decision Satisfaction

Other Intelligent Strategies

Direction associated to the location

- In Favour
- Against
- Null

Alternatives

- Brand_A1p
- Brand_B2er
- Brand_C3fr
- Brand_D4t

Criteria

- Price
- Consumption
- CO2
- Displacement
- Horse Power
- Top Speed
- Fuel

Text

Very good recent experience with their assistance service.

Some help goes here...

Send  Cancel
Introduction

Group Decision Support Systems for Current Times

- Overcoming the challenges of dispersed group decision-making

Goal

Decision-makers' Representation

Decision Satisfaction

Argumentation-based Dialogue Model

Developed Work

UbiGDSS/Web-based GDSS (Environment)

Other Intelligent Strategies

Conclusions

Future Work

Argumentation-based Dialogue Model

NEW MESSAGES

Pedro Alves

Very good recent experience with their assistance service.

14th Sep 23:15

Alternatives Criteria

Brand_A1p -

Evaluate

Disapprove

Approve

Take action

You are approving the message. Do you want to reinforce the idea with any extra knowledge? Text

Send

Cancel
Introduction

Group Decision Support Systems for Current Times

- Overcoming the challenges of dispersed group decision-making

Goal

Decision-makers' Representation

Decision Satisfaction

Other Intelligent Strategies

Developed Work

Argumentation-based Dialogue Model

Conclusions

Attack $\psi_1 \rightarrow \psi_2$

Reinforcement $\psi_1 \Leftrightarrow \psi_2$

Future Work

UbiGDSS/Web-based GDSS (Environment)

$\psi_9 \xrightarrow{\text{Prty}} \psi_8 \xrightarrow{\text{Prty}} \psi_3 \xrightarrow{\text{Prty}} \psi_2$

$\psi_1 \xrightarrow{\text{Prty}} \psi_4 \xrightarrow{\text{Prty}} \psi_5 \xrightarrow{\text{Prty}} \psi_6 \xrightarrow{\text{Prty}} \psi_7 \xrightarrow{\text{Prty}} \psi_13$

$\psi_{10} \xrightarrow{\text{Prty}} \psi_8 \xrightarrow{\text{Prty}} \psi_3 \xrightarrow{\text{Prty}} \psi_2$

$\psi_1 \xrightarrow{\text{Ev.} 0.5} \psi_4 \xrightarrow{\text{Ev.} 0.8}$

$\psi_2 \xrightarrow{\text{Ev.} 0.7}$

$\psi_3 \xrightarrow{\text{Ev.} 0.6}$

$\psi_4 \xrightarrow{\text{Ev.} 0.8}$

$\psi_5 \xrightarrow{\text{Ev.} 0.5}$

$\psi_6 \xrightarrow{\text{Ev.} 0.8}$

$\psi_7 \xrightarrow{\text{Ev.} 0.8}$

$\psi_10 \xrightarrow{\text{Ev.} 1.0}$

$\psi_9 \xrightarrow{\text{Ev.} -1.0}$

$\psi_3 \xrightarrow{\text{Ev.} -1.0}$

$\psi_2 \xrightarrow{\text{Ev.} -1.0}$
- A General Template to Configure Multi-Criteria Problems in Ubiquitous GDSS
- An Algorithm that allows Agents to Reason about Self-Expertise and other Decision-Makers’ Credibility
- A Communication Model that Simulates the Dialogues made by Decision-Makers in Face-to-Face Meetings
- An Algorithm that allows Agents to Analyse Tendencies
- A MCDA method that Includes Cognitive Aspects
Computer agents can act according to the style of behavior with which they are defined.

- Agents modeled with the proposed behavioral styles achieve higher levels of satisfaction and consensus
- A cooperative decision system that uses agents modeled with different behavioral styles benefits from this heterogeneity and do not present biased functioning
It is possible to predict the decision-makers’ perception of the decision quality.

- We can use this prediction in a negotiation model to maximize the decision quality
- Agents with the ability to predict satisfaction proved to be more capable as the more complex the problem was
An argumentation-based dialogue model is capable of improving the intelligence (of the agents or entities) and not only to reason about a solution.

- It is possible for both decision-makers and agents to use a dialogue which is clear to everyone involved in the decision-making process
- Both decision-makers and agents can take advantage of the knowledge which is generated
• Work on strategies to allow agents to intelligently use the assessments that the decision-makers make of the messages
• Develop intelligent reporting mechanisms
• Adapt the developed prototype to a specific context
• Create smarter models to deal with situations identified as “complex”
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