Real-Life Examples of MADM Applications

**Aims:**
- To get a feeling for MADM models
- To see the potential of MADM in practice

### Contents

1. INFORMATION TECHNOLOGY
   - evaluation of computer networks
   - evaluation of telecommunication technologies
   - evaluation of software products
2. PROJECtS
   - evaluation of project proposals
   - evaluation of project risk
   - project portfolio evaluation
3. COMPANIES
   - business partner selection
   - performance evaluation of companies

### Some Application Areas

1. INFORMATION TECHNOLOGY
   - personnel evaluation
   - selection of computer systems
   - evaluation of software products
2. HEALTH
   - risk assessment
   - diagnosis and treatment
3. OTHER AREAS
   - assessment of technologies
   - assessment of social and environmental impact
   - granting personal loans

### Allocation of Housing Loans

- Housing Fund of the Republic of Slovenia: Allocation of housing loans to families and non-profit organizations
- Since 1991-21 completed lots of loans for citizens (securing decision problem)
- Management decision support system for housing loan allocation
- Evaluation of loan priority: qualitative multi-attribute decision models (DEA)

20% of housing loans in Slovenia are allocated in this way


### Evaluation of R&D Projects

**Slovenian Ministry of Science and Technology**

![Multi-Attribute Model Structure](image-url)
Diabetic Foot Risk Assessment

**Who:**
- General Hospital Novo Mesto, Slovenia
- US
- Infornet, d.o.o.

**Why:**
- Reduce the number of amputations
- Improve the risk assessment methodology
- Improve the DSS module of clinical information system

**How:**
- Develop multi-attribute risk assessment model
- Evaluate it on patient data (about 3400 patients)
- Integrate into the clinical information system

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Environmental: Clay-Pit Location

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Clay-Pit Location Evaluation

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Environmental: Location of a Radioactive Waste Repository
Advising Children in Choosing Sports

Talent:

- A knowledge-based computer program
- for advising children in choosing sports
- in primary and secondary schools

Database of Measurements

<table>
<thead>
<tr>
<th>GENERAL DATA</th>
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<tbody>
<tr>
<td>Age</td>
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<tr>
<td>Gender</td>
<td></td>
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<td>Date of measurement</td>
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<table>
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<tr>
<th>MORPHOLOGICAL TESTS</th>
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<td>BH</td>
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<td>SP</td>
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<tr>
<th>MOTORIC TESTS</th>
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<td>BAH</td>
<td></td>
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<tr>
<td>ROO</td>
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</table>

Evaluation Models

Evaluation Model Structure

Evaluation and Explanation
Decision Problem: Housing (1/2)

Client:
The Housing Fund of the Municipality of Ljubljana

Task:
Support a lender for renovating old denationalized blocks of flats in Ljubljana

Problem characteristics:
- one-time problem

Decision Problem: Housing (2/2)

Earned financial resources:
600 M SIT (3 M €)

Timing: December 1999 – September 2000

Phases of the project:
1. application gathering
2. (in)completeness notification
3. application completion
4. loan approval and allocation
5. notifying applicants
6. handling complaints

DEX Application Ranking Model: Model Structure

Investment part

- Years in Ljubljana
  - (1) less than 10
  - (2) 10-20
  - (3) over 20
  - (4) highest priority

- Applicant
  - Age
  - Investment

- Advantages A (own flat)
  - Status
  - Earnings
  - Employment
  - Social Health
  - Health
  - Age
  - Children

- Advantages B (own risks)
  - Earnings from own risks
  - Number of non-profit flats

DEX Application Ranking Model: Decision Rules

APPLICANT

- (1) normal
- (2) priority
- (3) high priority
- (4) highest priority

Project Characteristics

- Business sector: Housing, Investment fund
- Decision problem type: one-time vs. recurring; two-lme
- Problem structure: structured vs. unstructured; semi-structured
- Problem definition: medium
- Organisational level: Managerial, Strategic, Management involved
- Methods used: model ng, qualitative ranking/giving weight on modes s, computational model s, data browsing/imaginative, what-if analysis
- Primary DSS elements: data, models
- Group decision problem: no (different interests)
- Group members: program ow net, 3 members; decision on analyses: 2
- Time span: 9 months

- Models: 2
  A. 17 attributes: 10 basic, 7 aggregate; 5 minis
  B. 10 attributes: 5 bag, 4 aggregate; 5 tasks
- Options: 10^9 + 256 = 367
Banks @ SI Housing Schema

Who:
- Slovenian Housing Fund
- US
- Temida

What:
- Evaluate and select banks for SHS
- Distribute rights for loan allocation to banks

Why:
- Difficult and sensitive decision problem

How:
- Combined quantitative/qualitative modelling

Assessment of Governmental Life-Event Portals

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
<th>Attribute scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Life-event portals</td>
<td>The number of available life-event portals</td>
<td>One-step, two-step, three-step, four-step, five-step</td>
</tr>
<tr>
<td>Access to services within particular LE</td>
<td>How well LE is covered with services</td>
<td>Unsuitable, dispersed, unsuitable, partly adequate, adequate</td>
</tr>
<tr>
<td>Elements of LE usage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Instruments to access e-services within LE</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vital Scope</td>
<td>How well LE is covered with vital services</td>
<td>Unsuitable, dispersed, unsuitable, partly adequate, adequate</td>
</tr>
<tr>
<td>FAQ</td>
<td>Frequently asked questions</td>
<td>One-step, two-step, three-step, four-step, five-step</td>
</tr>
<tr>
<td>Key Steps</td>
<td>List and description of key-steps within LE</td>
<td>One-step, two-step, three-step, four-step, five-step</td>
</tr>
<tr>
<td>LE Sophistication Level of life-event sophistication</td>
<td>How clear LE is presented to the user</td>
<td>Unsuitable, dispersed, unsuitable, partly adequate, adequate</td>
</tr>
</tbody>
</table>

Life-Event Portals Structure of Models

Structure of life-event portal

- Evaluation of LE portals as a whole
- Evaluation of LE portals at three levels
- Evaluation of e-services
Life-Event Portals
Model for Assessment of Portals

<table>
<thead>
<tr>
<th>Attribute</th>
<th>Description</th>
<th>Attribute scale</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name: LE</td>
<td>The name, which is the main difference between different LEs.</td>
<td></td>
</tr>
<tr>
<td>Creation Date</td>
<td>The date when the LEs were created, indicating their age.</td>
<td></td>
</tr>
<tr>
<td>Version</td>
<td>The version number, showing the update frequency.</td>
<td></td>
</tr>
<tr>
<td>Life-Status</td>
<td>The status of the LE, such as active, inactive, or pending.</td>
<td></td>
</tr>
</tbody>
</table>

Life-Event Portals
Assessment of Portals in 2002/2003

Genetically-Modified Crops
ECOGEN
Soil ecological and economic evaluation of genetically modified crops
QLK5-CT-2002-01666 2003-2006
http://www.ecogen.dk/

SIGMEA
Sustainable introduction of genetically modified crops into European agriculture
FP6-SSP1-2002-010562 2004-2006
http://sigmea.dyndns.org/

ECOGEN and SIGMEA Models
1. “Grignon” model
   Economic and ecological assessment of GM maize cropping systems
2. ESQ: ECOGEN Soil Quality Model
   Assessing the impact of cropping systems on soil quality
3. SMAC Advisor: SIGMEA Maize Coexistence
   Decision support software
   Assessing maize coexistence

“Grignon” Model
Model Output: Topmost Levels
Soil Quality Model
Assessment of ECOGEN Data

- All the soils have the same soil quality category of 3.
- The use of rice straw as mulch positively affects soil function with ECOGEN and soil biodiversity when used during the stage.
- Minimum irrigation levels.affects
- Ammonium nitrate as 
- Dinitrogen monoxime and 
- Dinitrogen monoxide 
- Feeding intense activity
- Bicunque reduces 
- Dinitrogen monoxide, but
- Bicunque 
- Ammonium nitrate.
- All terms and features. 
- Bicunque reduced by
- Any found polutions without affecting
- The higher level outcomes of Soil in nutrition, diversity and quality

SMAC Advisor
Decision Problem

Problem:
Can GM maize be grown in coexistence with plants on other fields?

Cost Test:
- Genetic drift (Adverse/neighbor)
- Typical target AP: 0.5%

Facts:
- pollen flow, volunteers, seed plants, mixing during harvest, transport, storage and processing human error, accidents...

SMAC Advisor Architecture

1. SMAC Advisor Wizard
   User Interface
2. Co-Existence Multi-Attribute DEXi Model
3. MAPCO Simulation Results

SMAC Advisor Level 2: DEXi Model

- Decision support software that assists the achievable AP given:
  - relation between field distance, relative size, wind effect, etc.
  - type and characteristics of used seeds
  - environmental characteristics (e.g., background GM pollen pressure)
  - use of machinery (e.g., sharing with other farmers)
  - target AP

... and gives recommendations:
- farming allowed
- farming disallowed
- assess risks (coexistence is possibly achievable)
- assess additional measures (coexistence feasible by small changes)
SMAC Advisor Level 2: DEXi Model

SMAC Advisor Level 1: User Interface

SMAC Advisor Level 1: User Interface

Summary

1. Loan Allocation
2. Evaluation/Selection of Projects
3. Medicine: Risk Assessment
4. Evaluation/Selection of Locations
5. Advising in Sports
6. Application ranking (in Housing)
7. Business partner selection (in Housing)
8. Assessment of Life-Event Portals

Other areas:
• evaluation of technology (cars, computers, software, Web pages and services, ...)
• evaluation of investment proposals, tenders
• production portfolio evaluation
• performance evaluation of companies
• personnel management

...