



Agile MCDA Modelling **XMCDA meets D⁴**

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Manchester, April 15, 2011
Cost Action IC0206 Algorithmic Decision Theory



Content

1. The D4 Rubis project
2. Use cases of XMCDA in D4
3. Granularity of the MCDA models
4. UMCDA-ML profiles and stereotypes
5. New horizons for XMCDA development



1. The D⁴ Rubis project



leopold-loewenheim.u... [] [] []

[Send Link](#) [Pr. Dr. Raymond B...](#) [UNILU](#) [D2](#) [Bisis](#) [Google Calendar](#) Other Bookmarks

[Logout](#)

[mainDoc](#) [addEditAlternatives](#) [addEditCriteria](#) [addEditPerformanceTable](#) [tuningCriteria](#) [compareAlternatives](#) [computeOutrankingRelation](#) [viewRubisSolution](#)

Distributed Web Application Designer (D⁴)

Version cawa July 2010 RB-UL

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Raymond Bisdorff (UL)

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User: raymond

 UNIVERSITÉ DU LUXEMBOURG

The screenshot shows the CAWA (Another Wheel of Agnosticism) application interface. A blue cloud-shaped callout points to the 'rubis' application entry in the 'Applications' list, with the text 'Rubis applications'. Another blue callout points to the 'User...' button in the 'Overview' panel, with the text 'Application users'. A third blue callout points to the 'User role' section in the 'Participations' table, with the text 'User role'. A large blue rectangular callout points to the 'rubis' project entry in the 'Packages' tree, with the text 'D4 Rubis project'.

Rubis applications

Application users

User role

D4 Rubis project

CAWA is Another Wheel of Agnosticism

leopold-loewenheim.uni.lu/cawa/home.do

Send Link Pr. Dr. Raymond B... UNILU

CAWA IDE Tools

[IDE] [Tools]

Packages

/ Package / projects / rubis

Name	Order
1 root	
2 cawa	
3 rand	
4 projects	
5 d4	
6 ebpa	
7 rubis	
8 demo_1	
9 rubis_UI	
10 rubis_VIEWS	
11 bestOffice	
12 demoSandbox	
users	

Overview

Run! User...

Name: rubis

Order:

Sandbox: projects.rubis.demo_1

Description: D4 Rubis best choice application

Entry points Shunting

Order Fragment

1 projects.rubis.rubis_UI.mainDesk

Applications Roles

Name	Published	Alias	Title
1 demo_1	<input checked="" type="checkbox"/>	demo	Rubis best choice d...
2 bestOffice	<input checked="" type="checkbox"/>	bestOffice	Choosing a best offi...
3 demoSandbox	<input checked="" type="checkbox"/>	sandbox	Test application of ...

Page 1 of 1 Displaying 1 - 3 of 3

Participations

User	Role
1 users.Raymond	projects.rubis.ADMIN
2 users.Gilles	projects.rubis.ADMIN
3 users.Michel	projects.rubis.ADMIN
	projects.rubis.READ_ONLY

Page 1 of 1 Displaying 1 - 4 of 4

[Model] [GUI] [Views] [Controllers] [Objects] [Users] [Detail]

Permissions of projects.rubis

User: rb



A diagram illustrating a user connection process. On the left, a blue cloud contains the text "User raymond Connects to D4". Below the cloud, three steps are listed: "Design the user pages" (with a gear icon), "Execute the application" (with a gear icon), and "D4" (with a gear icon). A horizontal line with blue circles connects the cloud to a login interface on the right. The login interface includes fields for "Login" (containing "raymond"), "First name", "Last name", "Email", and "Password", each with an associated input field. A "Remember me" checkbox is also present. A "Create an account *" button is at the top of the form, and a "Register" button is at the bottom.

User raymond Connects to D4

D4

Design the user pages

Execute the application

^2
WE

raymond

Remember me

Create an account *

Login

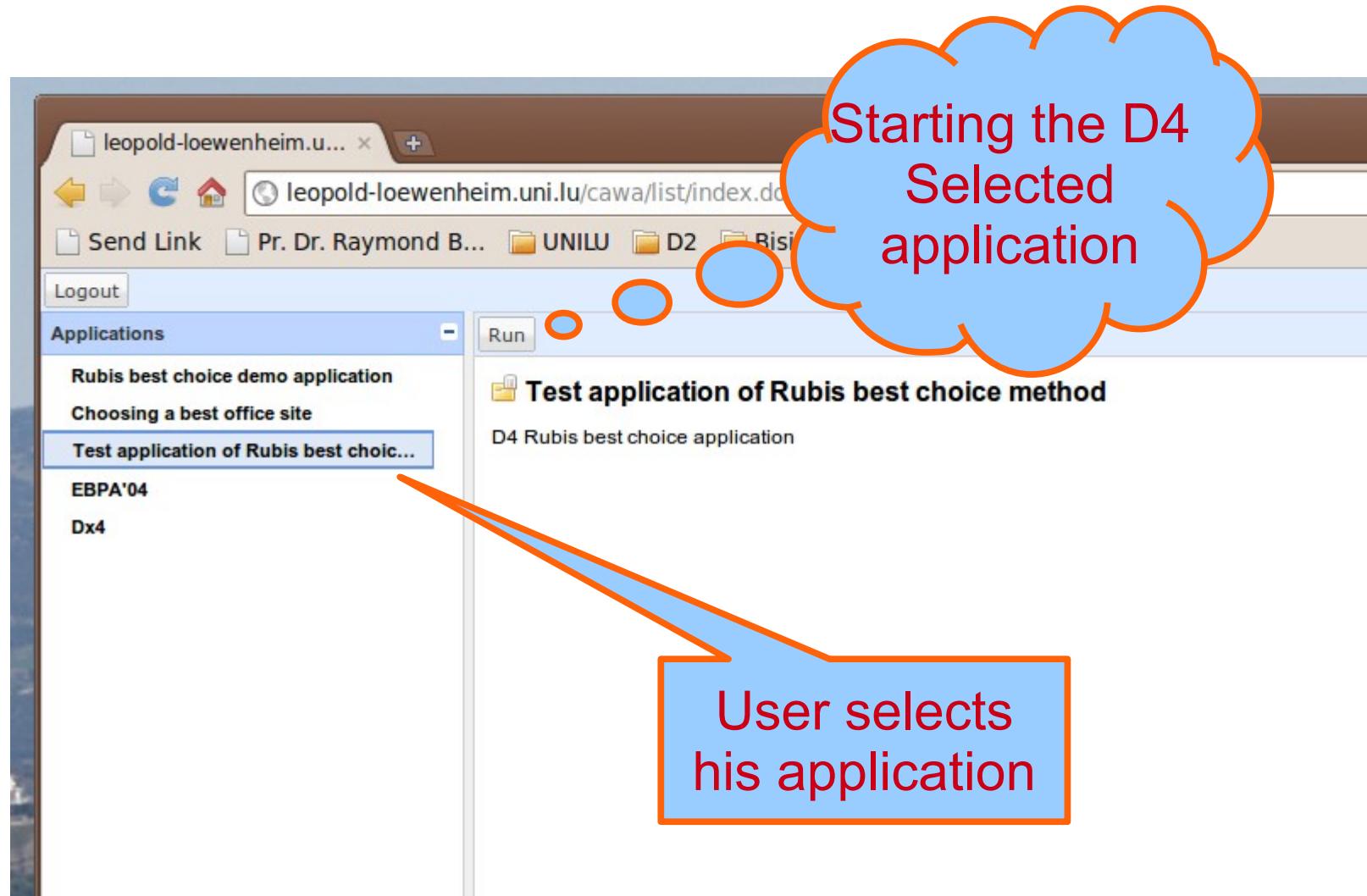
First name

Last name

Email

Password

Register





leopold-loewenstein.u... x

leopold-loewenstein.uni.lu/cawa/list/index.do

Send Link Pr. Dr. Raymond B... UNILU D2 Bisis Google Calendar Other Bookmarks

Logout

+ Applications mainDoc addEditAlternatives addEditCriteria addEditPerformanceTable tuningCriteria compareAlternatives computeOutrankingRelation

D4 MCDA Web APPLICATION

Computing a best choice recommendation with the RUBIS method *.

tabs	Content
addEditAlternatives	Edit the set of potential decision alternatives
addEditCriteria	Edit the family of performance criteria
addEditPerformanceTable	Add and edit the evaluations of the alternatives on each criterion
tuningCriteria	Add and edit the preference discrimination thresholds
computeOutrankingRelation	Compute a bipolar valued outranking digraph with a Condorcet robustness index, visualize the Condorcet oueraking graph and submit the problem to the RUBIS Solver
viewRubisSolution	Retrieve the completed best choice recommendation

*) R. Bisdorff, P. Meyer and M. Roubens (2008). RUBIS: a bipolar-valued outranking method for the choice problem. 4OR, A Quarterly Journal of Operations Research, Springer-Verlag, Volume 6 Number 2 pp. 143-165. (Online) Electronic version available at: <https://doi.org/10.1007/s10288-007-0045-5> (downloadable preliminary version PDF file 271.5Kb)

User: raymond

main steps of
the decision aid
process



a. Edit the set of potential alternatives

The screenshot shows a web browser window with the URL leopold-loewenheim.uni.lu/cawa/list/index.do. The page title is "leopold-loewenheim.u...". The main content area is titled "Add or edit the potential alternatives". It features a table with columns: order, name, description, active, and fullName. The table contains four rows labeled 1 through 4, each with a name (a, b, c, d) and a description (demo decision action 1 to 4). The "active" column has checked checkboxes for all rows. A red callout bubble with the text "Grid fragment" points to the bottom right of the table area. The bottom of the page includes navigation icons (back, forward, search), a page number (Page 1 of 1), and a user information bar (Displaying 1 - 4 of 4, User: raymond).

order	name	description	active	fullName
1	a	demo decision action 1	<input checked="" type="checkbox"/>	action 1
2	b	demo decision action 2	<input checked="" type="checkbox"/>	action 2
3	c	demo decision action 3	<input checked="" type="checkbox"/>	action 3
4	d	demo decision action 4	<input checked="" type="checkbox"/>	action 4



b. Edit the family of criteria

The screenshot shows a web browser window with the following details:

- Title Bar:** leopold-loewenheim.u... (partially visible)
- Address Bar:** leopold-loewenheim.uni.lu/cawa/list/index.do
- Toolbar:** Standard browser icons for Back, Forward, Stop, Refresh, etc.
- Bookmark Bar:** Send Link, Pr. Dr. Raymond B..., UNILU, D2, Bisis, Google Calendar, Other Bookmarks
- Header:** Logout, Applications (with icons for mainDoc, addEditAlternatives, addEditCriteria, addEditPerformanceTable, tuningCriteria, compareAlternatives, computeOutrankin)
- Content Area:** A table titled "addEditCriteria" showing the following data:

	name	description	active	significance	scaleMinimum	scaleMaximum	preferenceDirection
1	g01	ordinal criterion 1	<input checked="" type="checkbox"/>	1	0	6	max
2	g02	ordinal criterion 2	<input checked="" type="checkbox"/>	1	0	6	max
3	g03	ordinal criterion 3	<input checked="" type="checkbox"/>	1	0	6	max

At the bottom of the page:

- Navigation: Back, Forward, Home, Print, Refresh
- Page Information: Page 1 of 1, Displaying 1 - 3 of 3
- User Information: User: raymond



c. Edit the performances of the actions on the criteria

leopold-loewenheim.u... +

Send Link Pr. Dr. Raymond B... UNILU D2 Bisis Other Bookmarks

Logout

Applications

addEditPerformanceTable

Select an alternative

	id	Name
1	a	action 1
2	b	action 2
3	c	action 3
4	d	action 4

select a criterion

	id	name
1	g01	ordinal criterion 1
2	g02	ordinal criterion 2
3	g03	ordinal criterion 3

Page 1 of 1 Displaying 1 - 4 of 4

Page 1 of 1 Displaying 1 - 3 of 3

Edit the performances

+ showPerformanceTable

	name	description	value
1	p_a_g01	performance of alternative a01 on g01	6

Filtered performance

uni.lu UNIVERSITÉ DU LUXEMBOURG

The screenshot shows the CAWA application interface. On the left, there is a navigation bar with links to 'leopold-loewenheim.uni.lu/cawa/home.do' and other bookmarks like 'Send Link', 'Pr. Dr. Raymond B...', 'UNILU', 'D2', 'Bisis', and 'Google Calendar'. Below the navigation bar, there are two main tabs: '[IDE]' and '[Tools]'. The '[Tools]' tab is selected, showing several sub-tabs: '[Fragments]', '[Fragment Types]', '[Relation Types]', '[Libraries]', '[Property Categories]', '[Properties]', '[Attributes]', '[Relations]', '[Library Refs]', and '[Actions]'. The '[Relations]' tab is currently active.

The main area displays two tables. The first table, titled '/ Fragment / mainDesk / addEditPerformanceTable / addEditPerformance', lists various UI components with columns for 'Name', 'Order', 'Type', and 'Class'. The second table lists 'Relations' with columns for 'Name', 'Type', and 'Source'. A red arrow points from the text 'declarative definition of filtering conditions' to the relations table. Another red arrow points from the text 'Declarative definition of the tabs' to the bottom navigation bar.

[Fragments]

Name	Order	Type	Class
mainDesk		cawa.ui.templates.tab	
mainDoc	1	cawa.ui.templates.template	
addEditAlternatives	2	cawa.ui.templates.grid	projects.rubis.Alternative
addEditCriteria	3	cawa.ui.templates.grid	projects.rubis.Criterion
addEditPerformance	4	cawa.ui.templates.composite	
selectAlternative		cawa.ui.templates.grid	projects.rubis.viewAlternative
selectCriterion		cawa.ui.templates.grid	projects.rubis.viewCriteria
addEditPerformance		cawa.ui.templates.grid	projects.rubis.Performance
tuningCriteria	5	cawa.ui.templates.composite	
compareAlternatives	6	cawa.ui.templates.composite	
computeOutranking	7	cawa.ui.templates.grid	projects.rubis.OutrankingRel
viewRubisSolution	8	cawa.ui.templates.grid	projects.rubis.Recommendat
About	9	cawa.ui.templates.template	
problemInit		cawa.ui.templates.grid	projects.rubis.Problem
activeAlternatives		cawa.ui.templates.grid	projects.rubis.viewAlternative
outrankingSituations		cawa.ui.templates.grid	projects.rubis.OutrankingSitu

[Relations]

Name	Type	Source
r1	cawa.ui.relations.masterdetail	projects.rubis.rubis_UI.mainDes...
r2	cawa.ui.relations.masterdetail	projects.rubis.rubis_UI.mainDes...

[Properties]

Name	Value
targetAttribute	projects.rubis.Performance.alternative
sourceAttribute	

Declarative definition of filtering conditions

Declarative definition of the tabs



View the entire performance table

use D⁴ Python scripting

Performance table

criterion	a	b	c	d
g01	6.00	4.00	2.00	0.00
g02	2.00	0.00	6.00	4.00
g03	4.00	2.00	0.00	6.00

Edit the performances

showPerformanceTable

name	description	value
1 p_a_g01	performance of alternative a01 on g01	6



leopold-loewenstein.uni.lu...

Send Link Pr. Dr. Raymond B... UNILU D2 Bisis Google Calendar Other Bookmarks

Logout

+ Applications mainDoc addEditAlternatives addEditCriteria addEditPerformanceTable tuningCriteria compareAlternatives computeOutrankingRelation viewRubisSol

Select the criterion to be tuned

	id	significance	description
1	g01	1	ordinal criterion 1
2	g02	1	ordinal criterion 2
3	g03	1	ordinal criterion 3

d. Tuning the preference discrimination

Add or edit the preference discrimination thresholds

	name	description	type	value	intercept	slope
1	th_g01_pref	preference discrimination threshold	pref	2	0	
2	th_g01_ind	constant indifference discrimination	ind	1		

declarative definition of thresholds

Page 1 of 1

Displaying 1 - 2 of 2

User: raymond

LUXEMBOURG

leopold-loewenheim.u... ×

leopold-loewenheim.uni.lu/cawa/list/index.do

Send Link Pr. Dr. Raymond B... UNILU D2 Bisis Google Calendar Other Bookmarks

Logout

Applications

Select the initial alternative

	id	Name
1	a	action 1
2	b	action 2
3	c	action 3
4	d	action 4

Select the terminal alternative

	id	Name
1	a	action 1
2	b	action 2
3	c	action 3
4	d	action 4

outrankingRelation_a_c

Pairwise Comparison
Comparing actions : (a,c)

crit.	wght.	g(x)	g(y)	diff	ind	wp	p	concord	wv	v	polarisation
g01	1.00	6.00	2.00	+4.00	1.0	None	2.0	+1.00			
g02	1.00	2.00	6.00	-4.00	1.0	None	None	-1.00			
g03	1.00	4.00	0.00	+4.00	1.0	None	None	+1.00			

Valuation in range: -3.00 to +3.00; global concordance: +1.00

Displaying 1 - 4 of 4

Filtered outranking situation

showPairwiseComparison

order name

1 outran

Displaying 1 - 1 of 1

User: raymond



e. Computing the bipolar valued outranking digraph

outrankingRelation

problemDemo_1: Bipolar-valued adjacency table of outrankingRelation

Relation	a	b	c	d
a	0.00	3.00	0.00	-1.00
b	-3.00	0.00	0.00	-1.00
c	-1.00	-1.00	0.00	0.00
d	0.00	0.00	-1.00	0.00

Valuation domain: from -3 to 3 .

Page 1 of 1

Displaying 1 - 1 of 1

User: raymond

16

The screenshot shows a web-based application interface for computing outranking relations. The main window displays a table titled "problemDemo_1: Bipolar-valued adjacency table of outrankingRelation". The table has four columns and four rows, labeled "a", "b", "c", and "d" respectively. The diagonal elements (a-a, b-b, c-c, d-d) are all 0.00. The off-diagonal elements represent the outranking relations between pairs of objects. The values are colored according to their magnitude: green for positive values (e.g., 3.00), red for negative values (e.g., -3.00), and grey for zero values. Below the table, a message states "Valuation domain: from -3 to 3 .". At the bottom of the page, there is a navigation bar with links like "Send Link", "Pr. Dr. Raymond B...", "UNILU", "D2", "Bisis", "Google Calendar", and "Other Bookmarks". On the left, there is a sidebar with "Logout" and "Applications" sections. A large black rectangular box covers the top portion of the screenshot, obscuring some of the menu items. The number "16" is located in the bottom right corner.

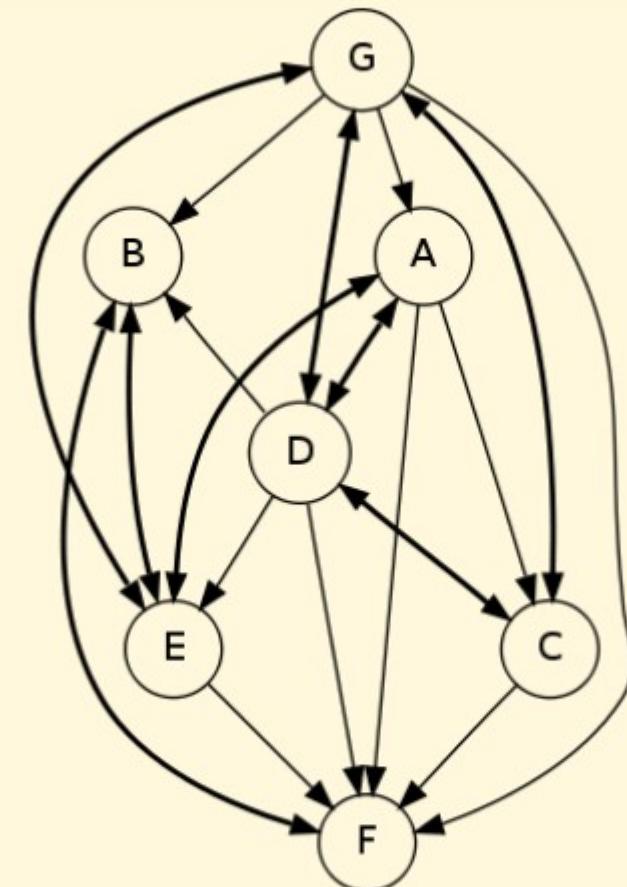


Logout

+ Applications

mainDoc addEd...
order
1

outrankingRelation

*Rubis Python Server (graphviz), R. Bisdorff, 2008*

Page 1 of 1



Displaying 1 - 1 of 1

User: raymond

The screenshot shows a web browser window with the URL leopold-loewenheim.uni.lu/cawa/list/index.do. The page title is "Decision-Deck UMCDA-ML-2.0 Application". The main content area displays the "Rubis Best Choice Recommendation" for the "D4 Rubis Project". The recommendation includes a comment ("produced by stringIO()"), version ("D4 cawa August 2010"), and author ("D4 rubis application"). A list of content items is provided, including "Choice Recommendation", "Outranking digraph", "Potential decision actions", "Performance table", "Family of criteria", "Criteria ordinal correlation", and "Outranking relation". A sidebar on the left lists various applications such as mainDoc, addEditAlternatives, addEditCriteria, addEditPerformanceTable, tuningCriteria, compareAlternatives, computeOutrankingRelation, viewRubisSolution, and About. The bottom of the page shows navigation links for "Page 1 of 1" and "Displaying 1 - 1 of 1".

Solution sucessfully retrieved

Decision-Deck UMCDA-ML-2.0 Application

Rubis Best Choice Recommendation

D4 Rubis Project

Comment: *produced by stringIO()*
Version: D4 cawa August 2010
Author: D4 rubis application

Content

- [Choice Recommendation](#)
- [Outranking digraph](#)
- [Potential decision actions](#)
- [Performance table](#)
- [Family of criteria](#)
- [Criteria ordinal correlation](#)
- [Outranking relation](#)

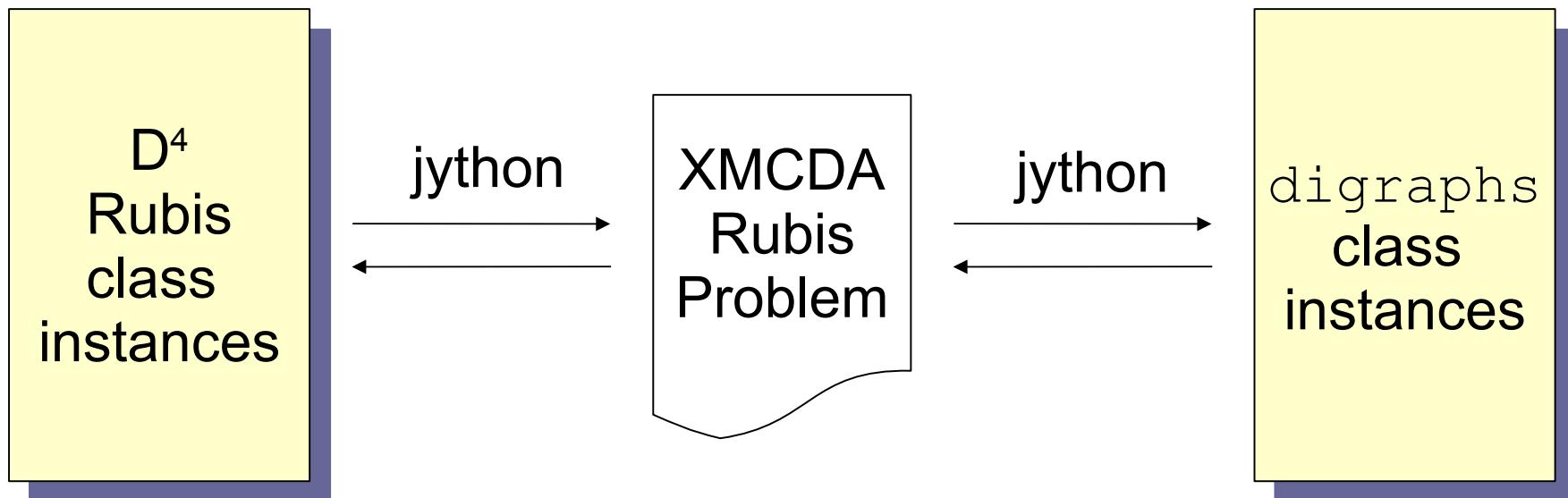
f. Get Rubis best choice recommendation from the Rubis Solver web service



2. Use cases of XMCDAs in D⁴



a. Interfacing D⁴ and digraphs class instances





Example: showing the pairwise comparison table

The screenshot shows a software interface with three main panes. The left pane is titled 'Classes' and lists various entities: Problem, Alternative, Criterion, OutrankingSituation (selected), Recommendation, Performance, Threshold, ConstantThreshold, ProportionalThreshold, OutrankingRelation, viewAlternatives, viewCriteria, and viewTuningCriteria. The middle pane is titled 'Operations' and shows a single operation named 'showPairwiseComparison'. The right pane displays a Python code snippet:

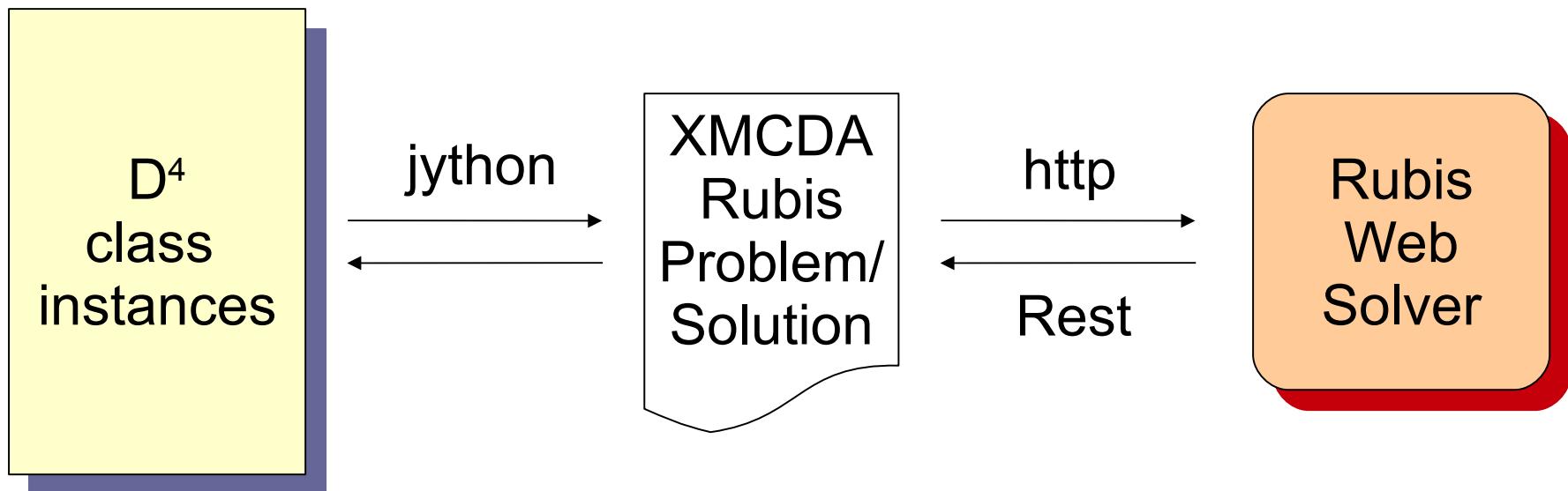
```
import digraphs
# this is the current selected outranking situation
print this.name
if this.initial.name != this.terminal.name:
    t = digraphs.XMCDA2PerformanceTableau(stringInput=this.digraph.performanceTableau)
    if this.digraph.noVeto:
        g = digraphs.BipolarOutrankingDigraph(t, hasNoVeto=True)
    else:
        g = digraphs.BipolarOutrankingDigraph(t, hasBipolarVeto=True)
    initialAction = str(this.initial.name)
    terminalAction = str(this.terminal.name)
    html = g.showPairwiseComparison(initialAction, terminalAction, isReturningHTML=True)
    print html
    return html
else:
    return 'Error: can only compare non identical posters !'
```

Annotations in red text and boxes highlight specific parts of the interface:

- A box labeled 'D4 class definition' encloses the list of entities in the 'Classes' pane.
- A box labeled 'class operation' encloses the 'Operations' pane.
- A large callout bubble points from the 'Operations' pane to the explanatory text below, stating: "The class instance has a pointer to an XMCDA encoded instance of a complete Rubis PerformanceTableau".



b. Interfacing D⁴ and the Rubis XMCDA Solver





D4 class definition

[Classes] [Diagram]

Name	Order
1 Problem	
2 Alternative	
3 Criterion	
4 OutrankingSituation	
5 Recommendation	
6 Performance	
7 Threshold	
8 ConstantThreshold	
9 ProportionalThreshold	
10 OutrankingRelation	
11 viewAlternatives	
12 viewCriteria	
13 viewTuningCriteria	

[Attributes] [Operations] [Instances]

Name	Order
2 resources	
3 computeCharacteristics	
4 computeRobustness	
5 showRelationTable	
6 showCriteriaCorrelation...	
7 showRobustnessTable	
8 showGraphImage	
9 submitRubisJob	
10 viewProblemSource	

Page 1 of 1

```
import sys,xmlrpclib
host = "http://localhost/cgi-bin/xmlrpc_cgi.py"

rubisServer = xmlrpclib.ServerProxy(host)

#this = weta.core.loader.load('projects.ebpa.data2004.globalOutranking')

problemText = this.performanceTableau
arg = {'problemFile': problemText.encode('ascii', 'xmlcharrefreplace')}
#arg = {'problemFile': problemText}
answer = rubisServer.submitProblem(arg)
print answer['ticket']
html = answer['message']
if answer['ticket'] != None:
    Job = weta.core.loader.load('projects.rubis.Recommendation')
    job = Job()
```

class operation

D4 python xmlrpc exchange with the Rubis Solver



leopold-loewenheim.u...

leopold-loewenheim.uni.lu/cawa/list/index.do

Send Link Pr. Dr. Raymond B... UNILU D2 Bisis Google Calendar Other Bookmarks

Logout

+ mainDoc addEditAlternatives addEditCriteria addEditPerformanceTable tuningCriteria compareAlternatives computeOutrankingRelation viewRubisSolution About

Applications

viewRubisBestChoice viewProblemSource viewSolutionSource

order	name	description	ticket	problemText	solverMessage	solutionText
1	job-VWOdoUDwXdue2E8r	Complete Solution; With L...	VWOdoUDwXdue2E8r	D4 rubis application D4 ca...	The solution request was ...	D4 Rubis Project produc

job-VWOdoUDwXdue2E8r

```
<?xml version="1.0" encoding="UTF-8"?>
<!-- ?xml-stylesheet type="text/xsl" href="xmcd2Rubis.xsl"? -->
<xmcda:XMCD4 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.decision-deck.org/2009/XMCDA-2.0.0 http://www.decision-deck.org/xmcd4/_downloads/XMCDA-2.0.0.xsd" xmlns:xmcd4="http://www.decision-deck.org/2009/XMCDA-2.0.0" instanceID="void">
<projectReference id="d4_rubis_temp" name="d4_rubis_temp.xml">
<title>D4 Rubis Project</title>
<author>D4 rubis application</author>
<version>D4 cawa August 2010</version>
<comment>produced by stringIO()</comment>
</projectReference>
<methodParameters id="Rubis" name="Rubis best choice method" mcdaConcept="methodData">
<description>
<subTitle>Method parameters</subTitle>
<version>1.0</version>
</description>
<parameters>
<parameter name="variant">
<value>
<label>Rubis</label>
</value>
</parameter>
<parameter name="valuationType">
<value>
<label>bipolar</label>
</value>
</parameter>
```

Page 1 of 1 Displaying 1 - 1 of 1 User: raymond

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UMCDAML perspectives

Learning from the D4 experience



Motivation

- D4 ?
 - Power-User design tool for MCDA problems
 - No deployment cycle : app online from the begining
 - Fast : new class in minutes
 - Flexible : refactoring with instant impact to data
- Only enrolling you ?
 - Technological war ?



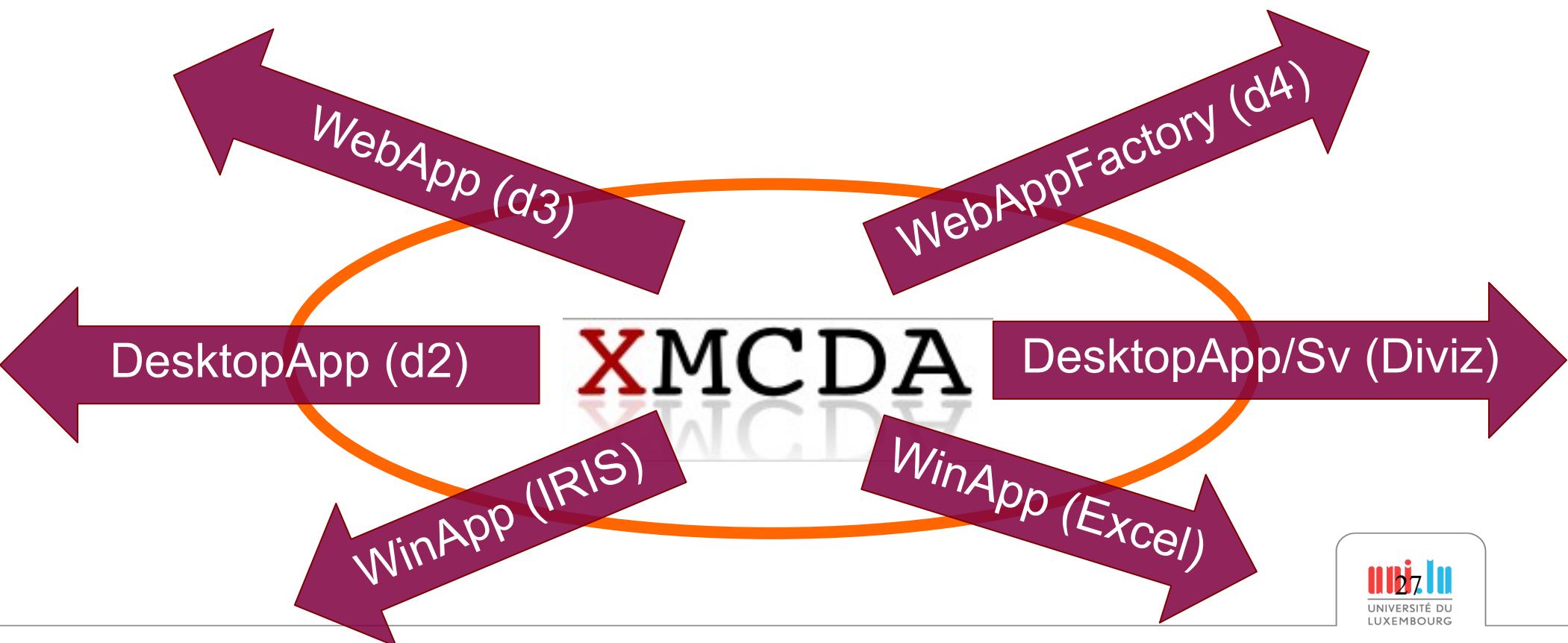
High stakes :
raise abstraction

Motivation

UMCDA ML

Technology
vs methodology

...

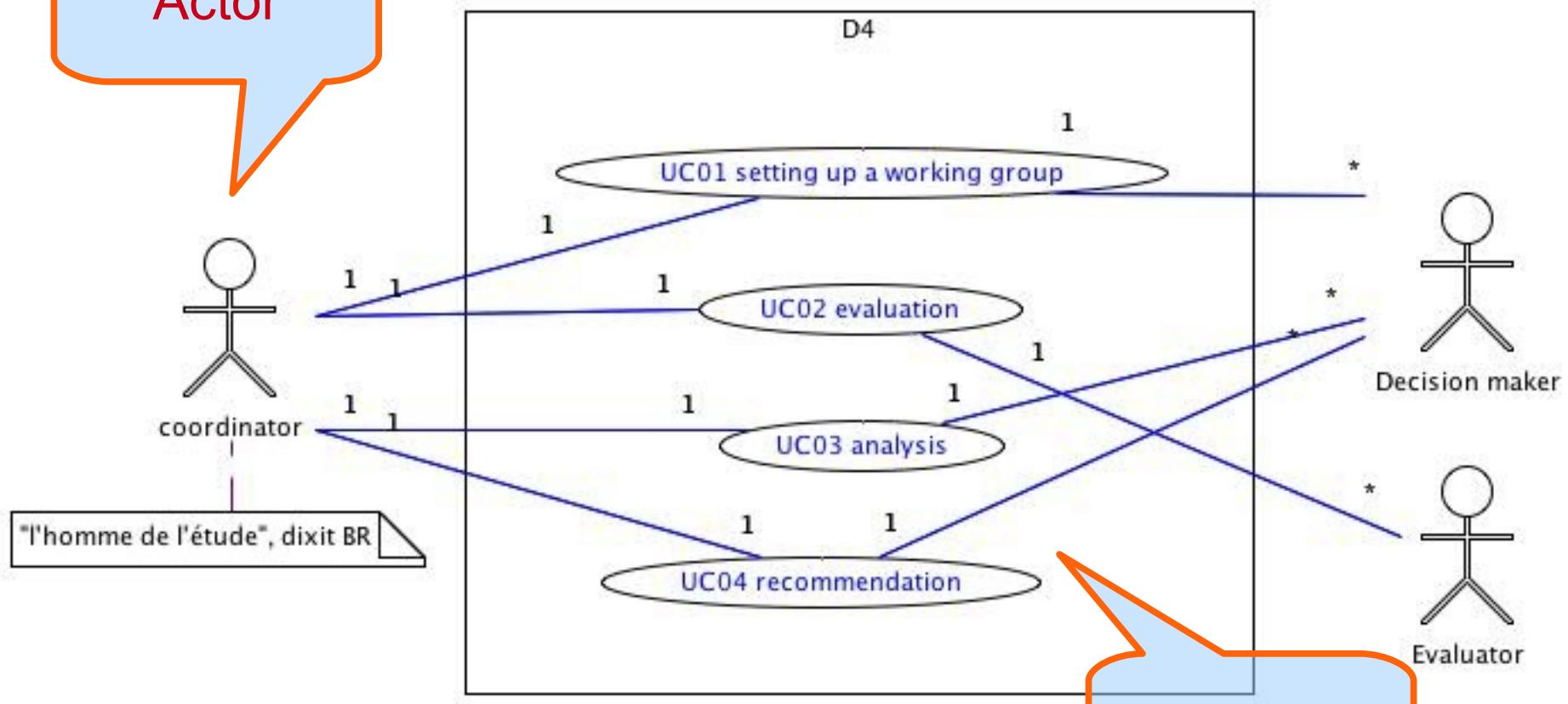




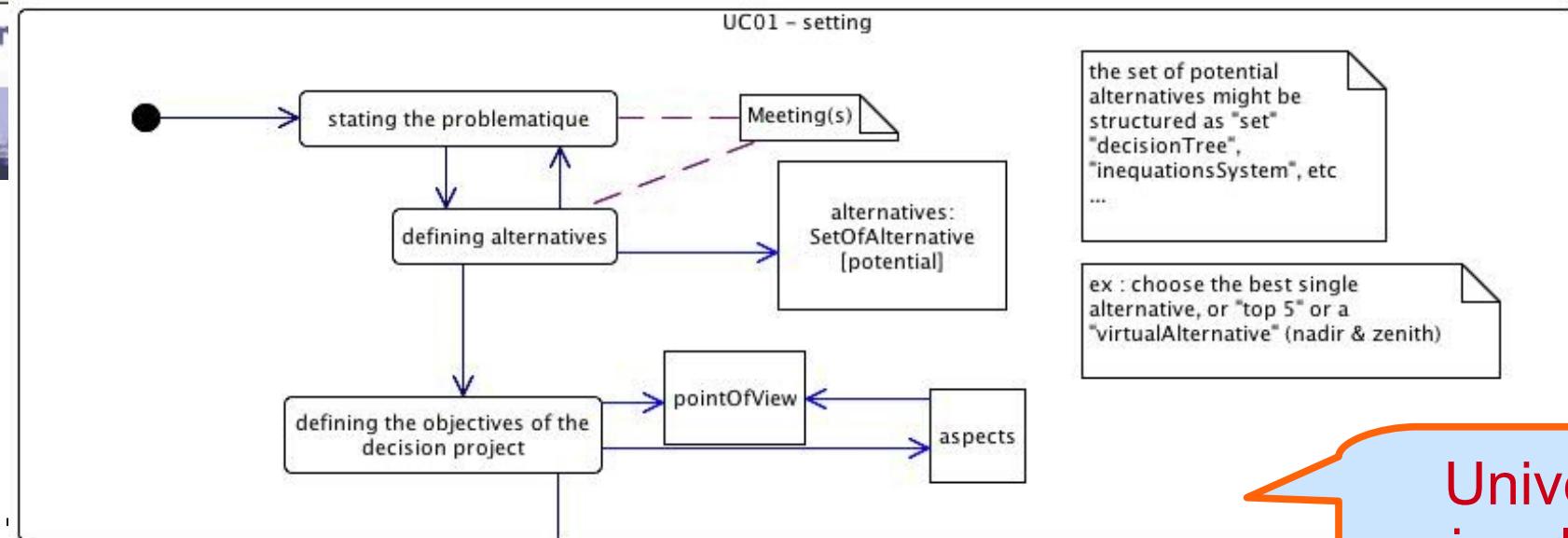
Multi platform, multi language ...

Modeling MCDA problems with UML

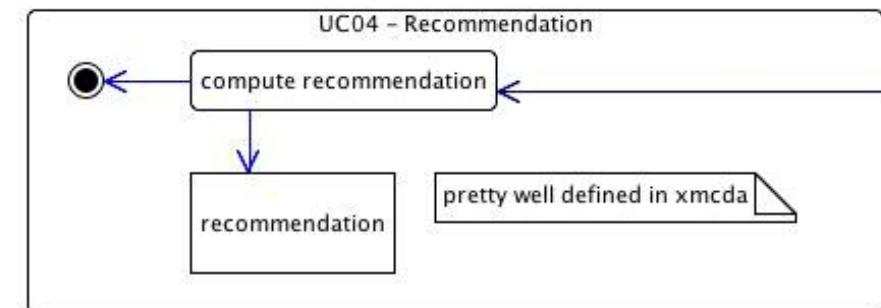
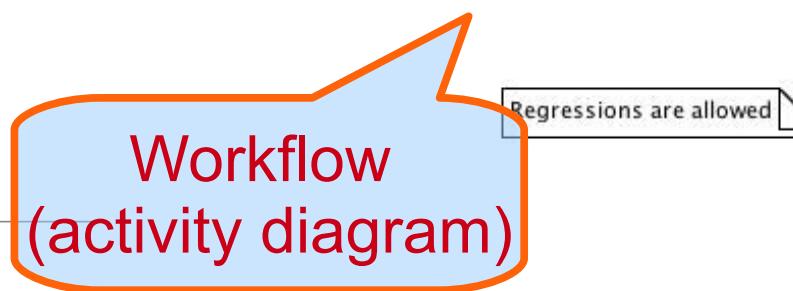
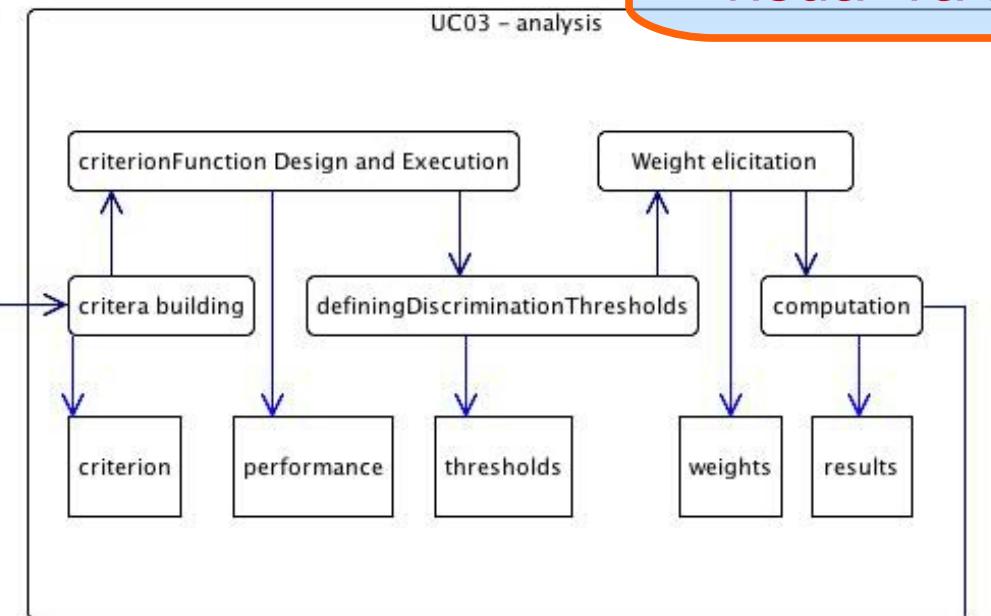
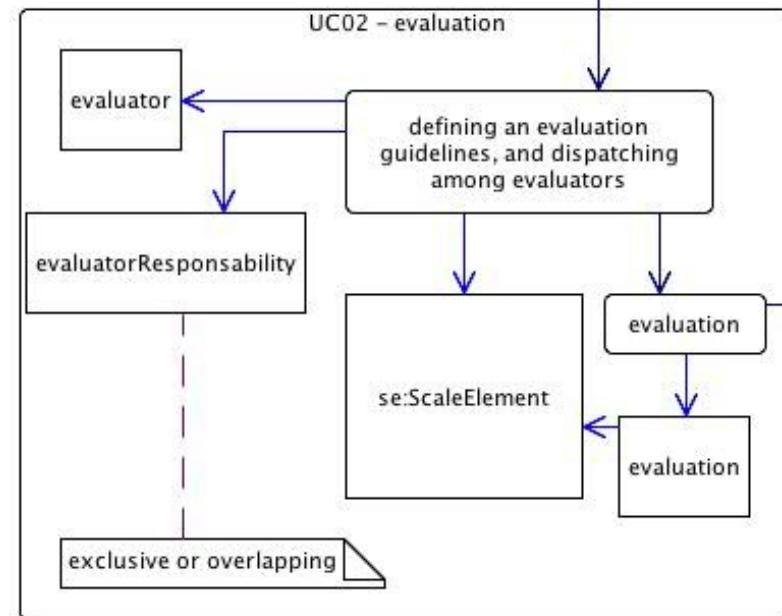
Actor



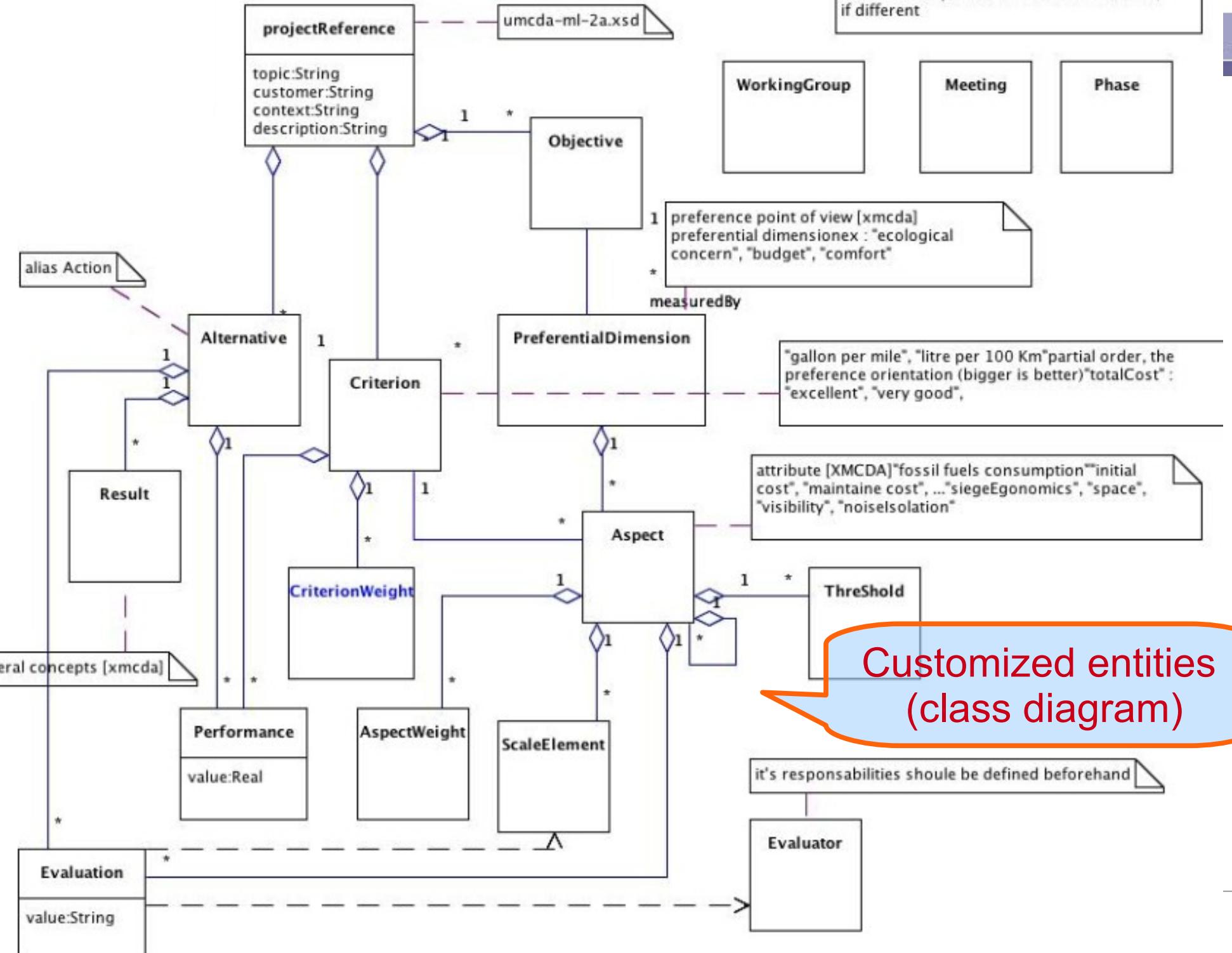
Use Cases



Universal visual value



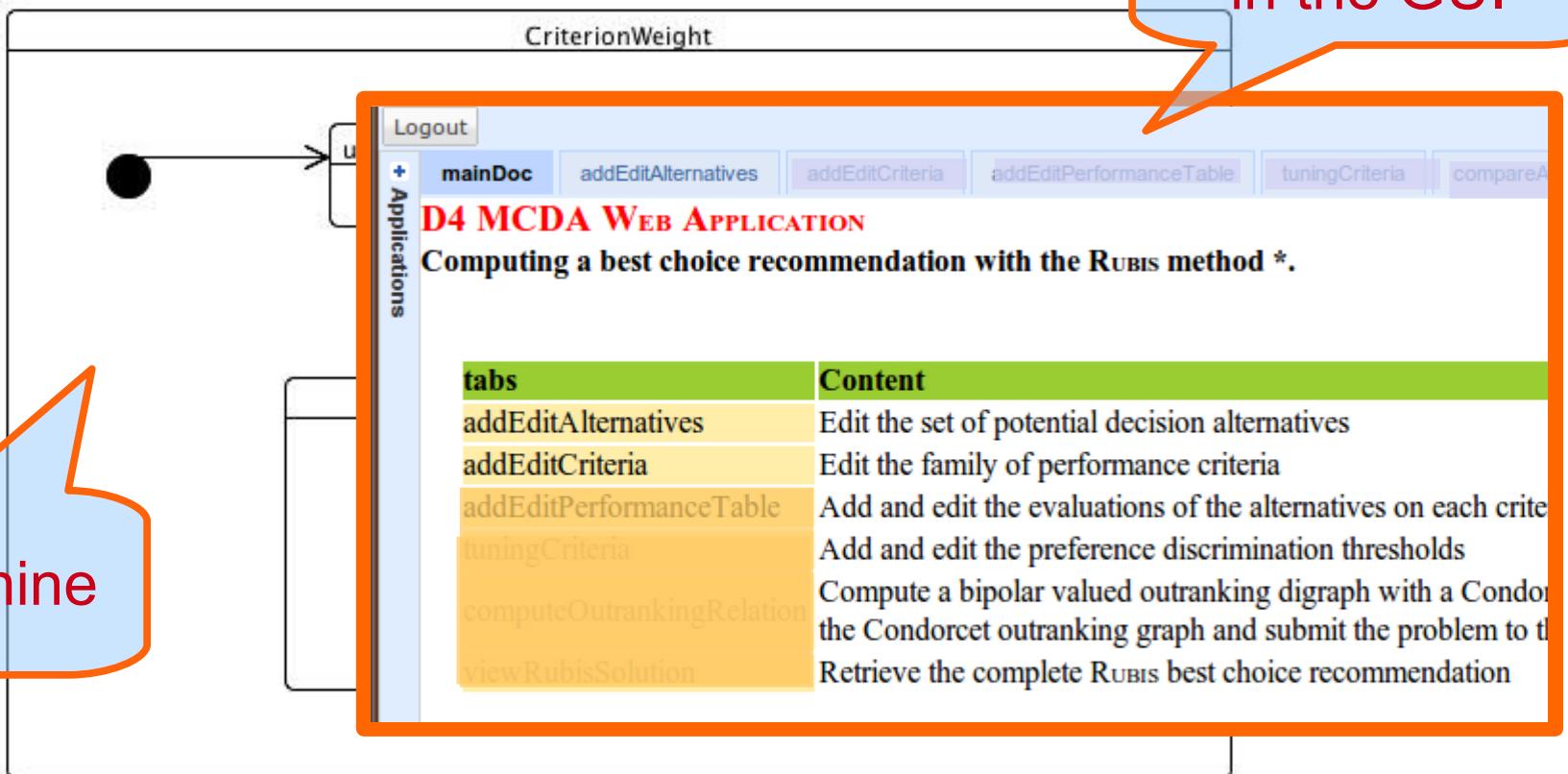
class names are more abstract
links with xmcdal concepts are documented in notes,
if different





Object's lifecycle : workflow regulator

...

**StateMachine****Can be reflected
in the GUI**

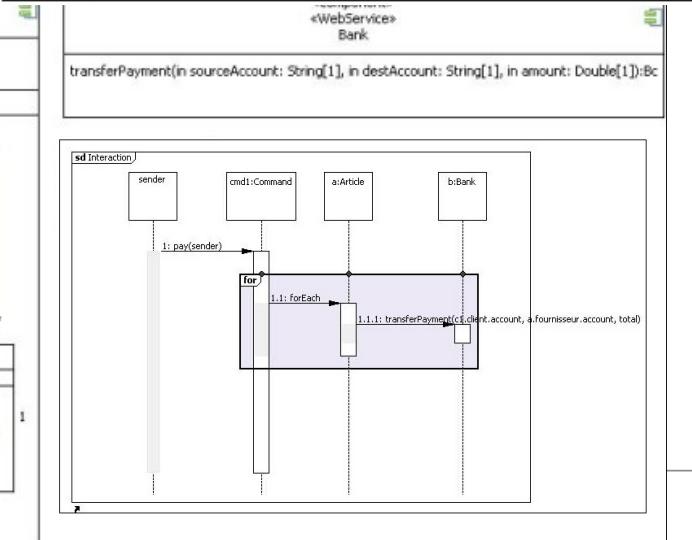
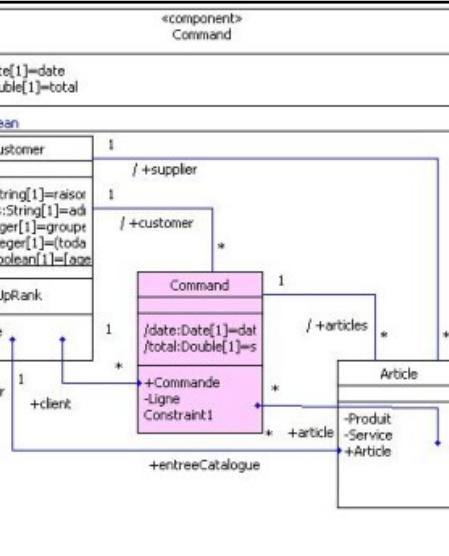
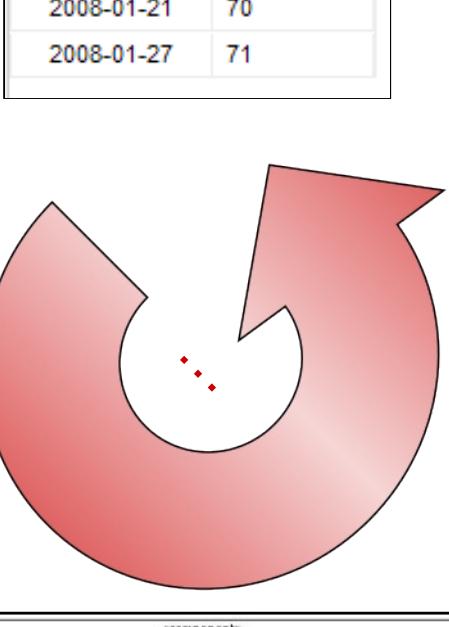
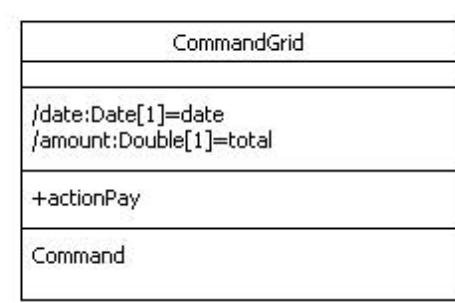
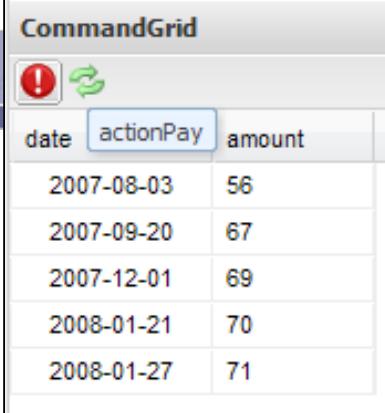
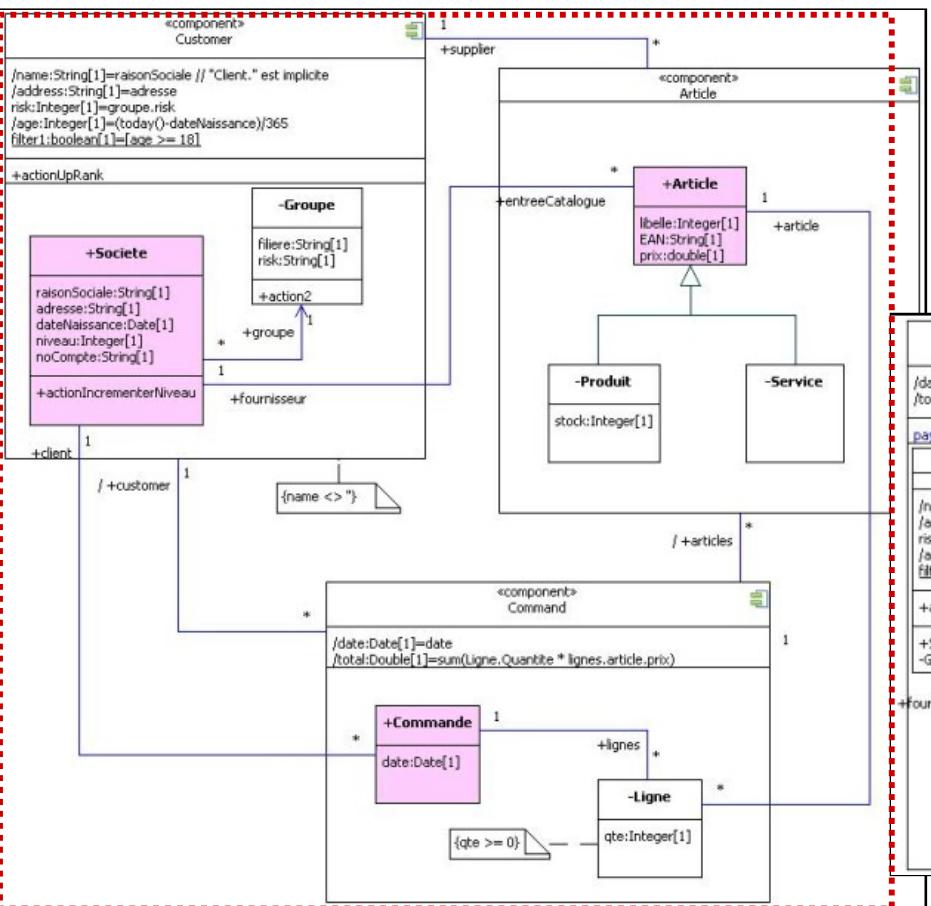
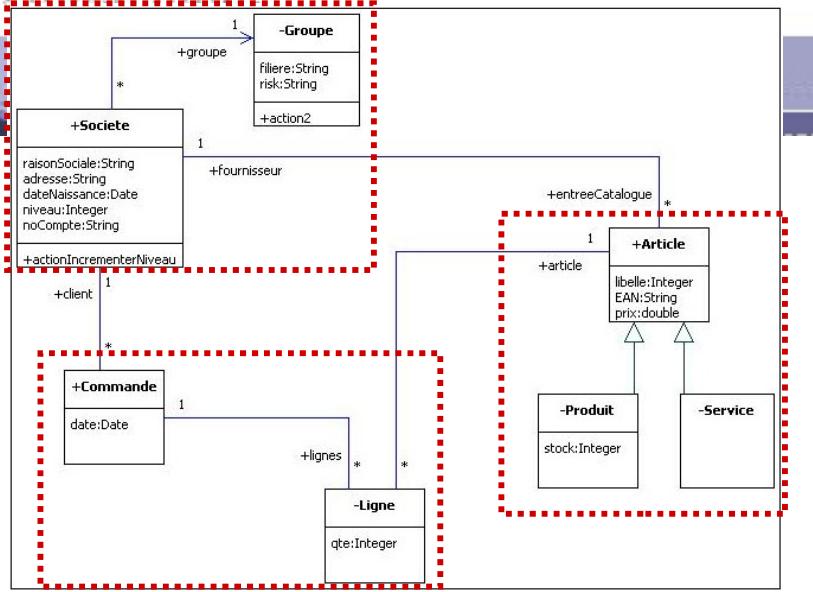


3. Granularity of the MCDA models



UML granularity concepts

- Model
 - Static : package*, class*, component*
 - Dynamic : usecase, activity*, state*, operation*
- Metamodel solution
 - (*) : Composite design pattern
 - XMI : **XML Model Interachange**





3. UMCDA-ML profiles and stereotypes



UML Profile

- **Profile**
 - provides a generic extension mechanism for customizing UML models for particular domains and platforms.
 - define new concepts (meta) called << stereotypes >>
more than types, less than metatypes
 - model remain compliant with the standard
 - finally, the standard can evolve and integrate the stereotype as an official new concept



3. New horizons for XMCDa ?



XMCDA

- UML-like profiles and stereotypes
 - Needs a tool for diagrams and generation
 - <<problem>>, <<package>>,
 - <<phase>>, <<workflow>>
- Types aggregates : java-like generics
 - Using Spring parsing features
 - Set<Alternative>, List<Evaluator> ...
 - Matrix<Alternative, Evaluator, Criteria> ...



Methdological power

Strong methodological concepts +
xMCDA ML
Rich exchange mechanisms
(xMCDA + WebServices)
=> Technological diversity becomes an asset

DesktopApp (d2)

DesktopApp/Sv (Diviz)

WinApp (IRIS)

WinApp (Excel)

Technological freedom



Q&A