

Cooperative Decision Support Systems

Pascale Zaraté

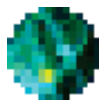
Professor University Toulouse 1 Capitole

Laboratory IRIT ; SMAC Team



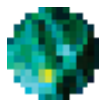
Decision Support

- Decision Making Rational Methodologies
 - Alternatives perfect evaluation, criteria
 - Limited Rationality Principle
- Decision Making Non Rational Methodologies
 - Implicit Favourite Model
 - Organisational Anarchy
- *Roy and Bouyssou (1993)* :
 - First Order Reality Postulate
 - Decision Maker Postulate
 - Optimum Postulate

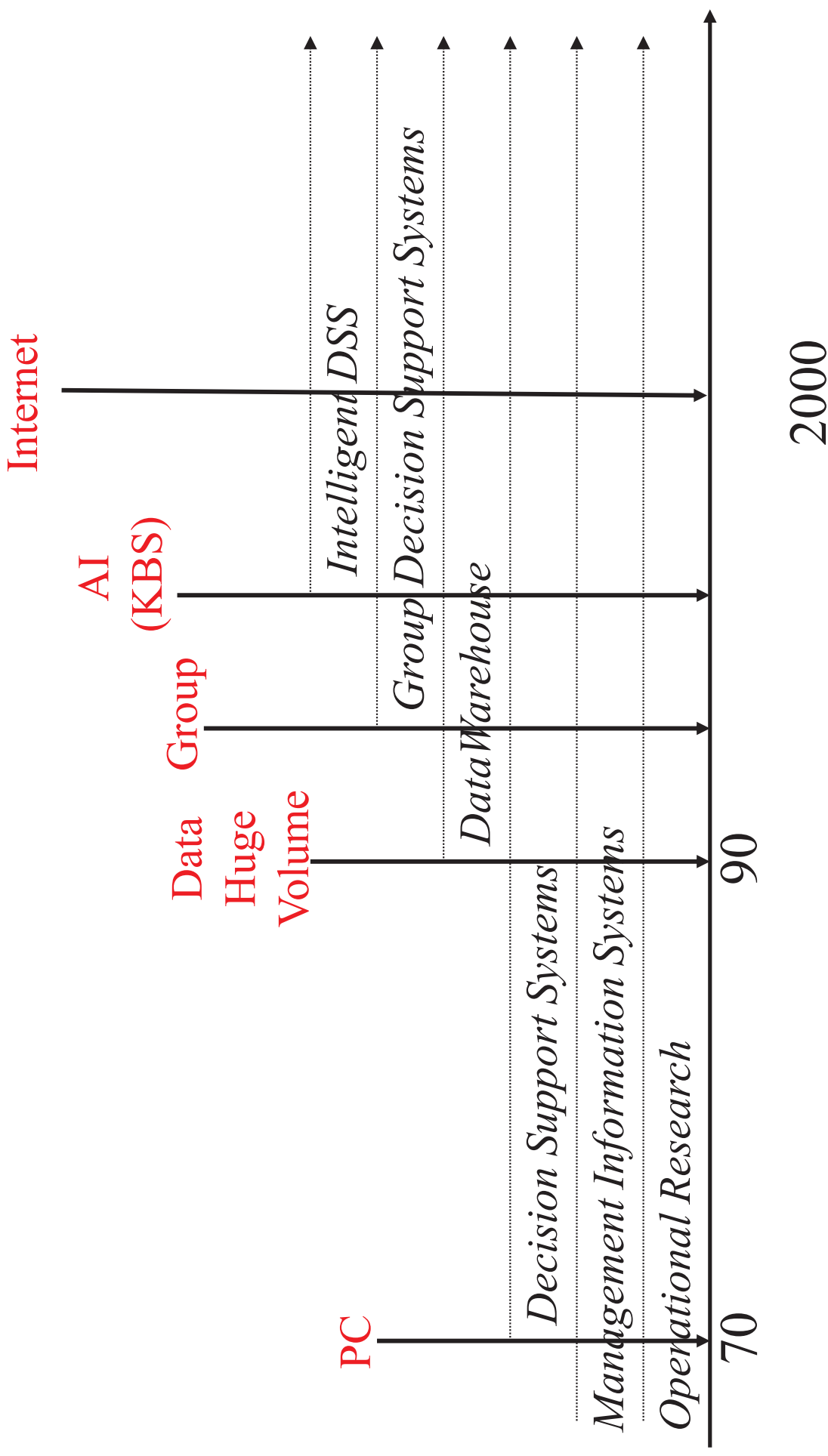


Decision Support

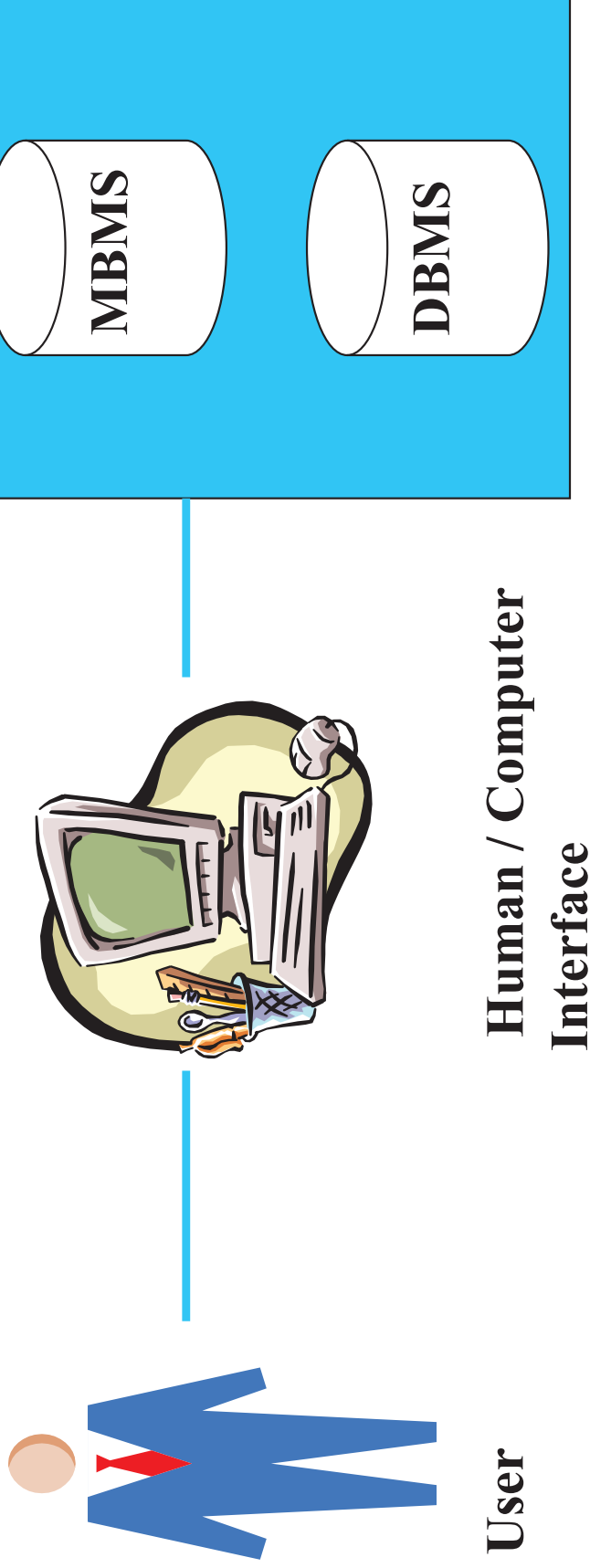
- Limited Rationality Principle (*H. Simon, 1969*)
 - No optimisation but satisficing solution research (best consensus) : **satisficing**
 - Decisions Made one by one in a limited area
 - Progressive Process
 - Decision Makers can use contradictory criteria
 - No more Global Utility Function (Contradiction with *Von Neumann and Morgenstern's* hypothesis)



Decision Support Systems (DSS)



DSS



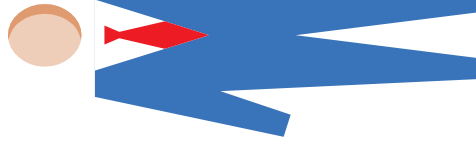
Sprague and Carlsson (1982)

➔ **Interactive Optimization**

DSS

- *Keen and Scott Morton (1978)* :
 - Support decision makers in their **semi-structured** decision making processes
 - **Help** rather than replace decision makers judgment
 - **Improve** effectiveness(+) and efficiency of decision making.

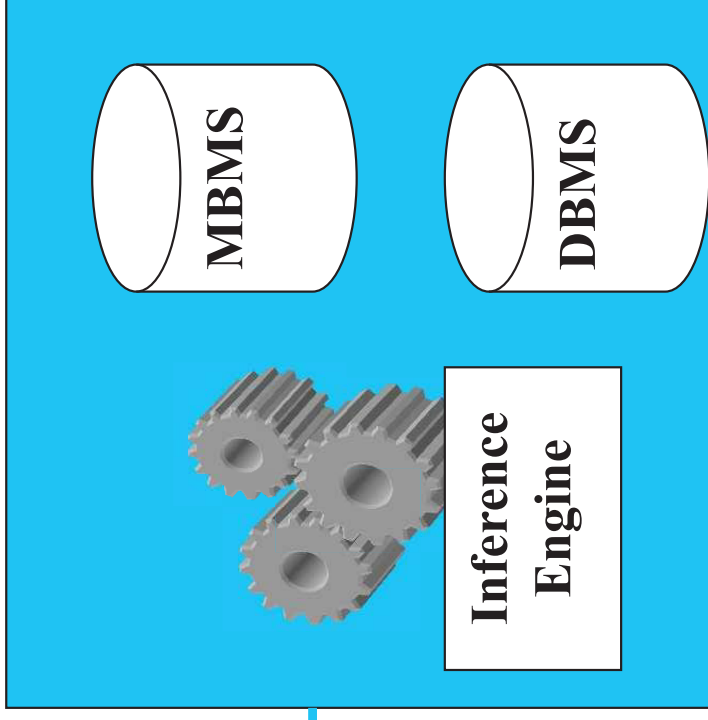
Intelligent DSS



User



**Human / Computer
Interface**



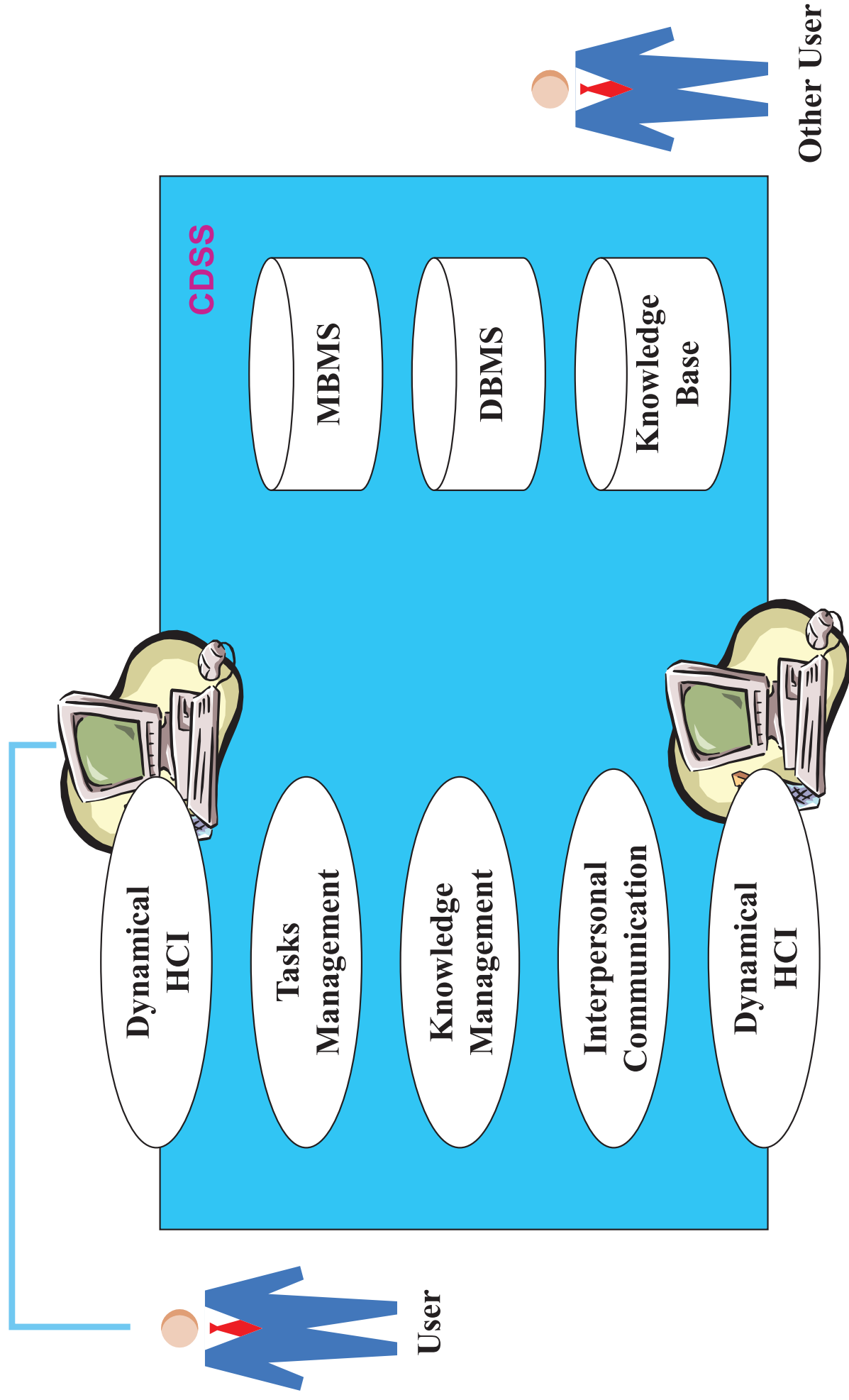
Marakas (2003)

➔ **Cooperative Designing Approach**

ICT Introduction

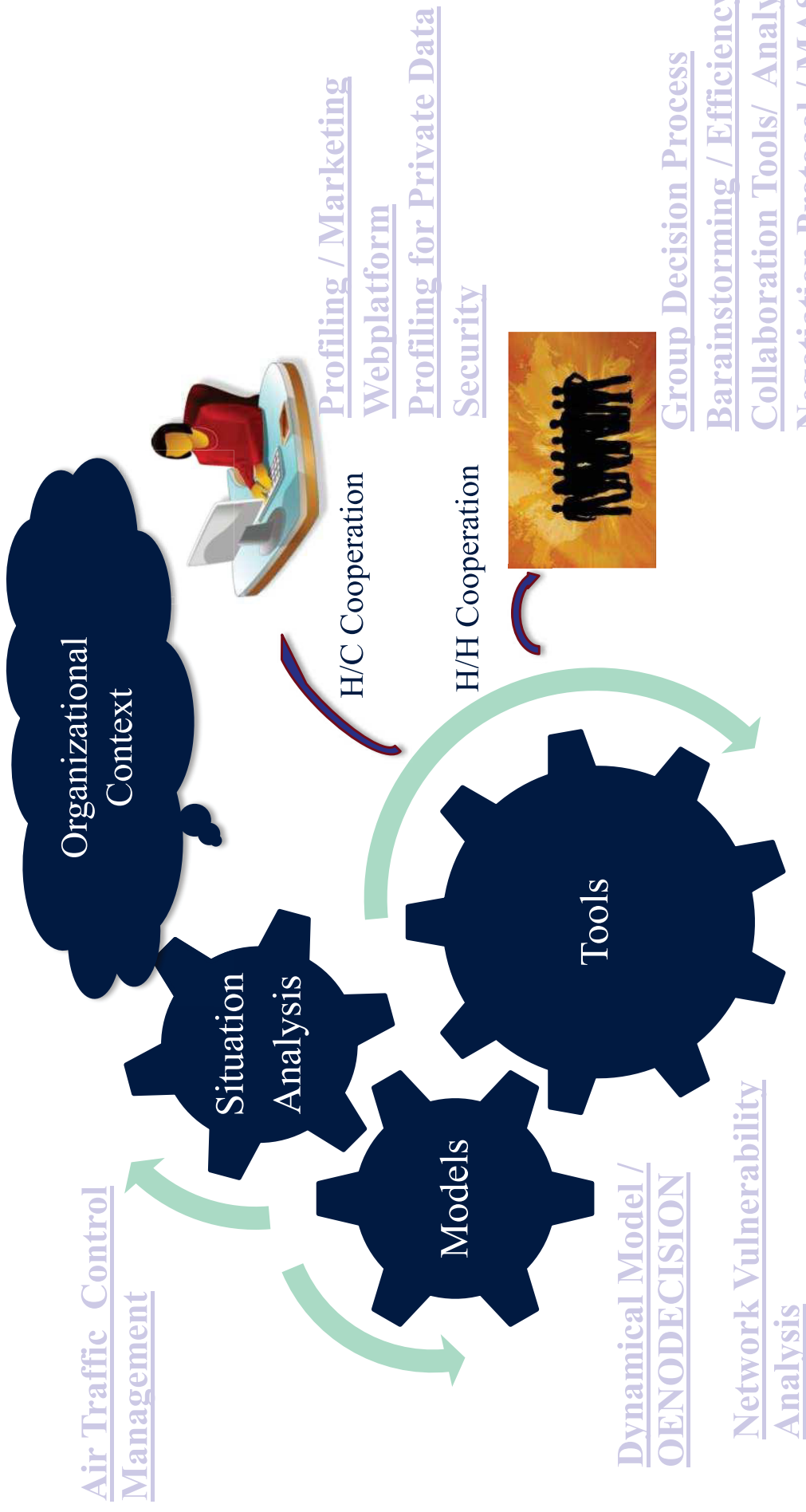
- **ICT : Decision Making processes modification**
 - **Organisational : Multi-actors**
 - **Cognitive : Sorting Step reinforcement**
- **Cooperative Decision**

Cooperative DSS

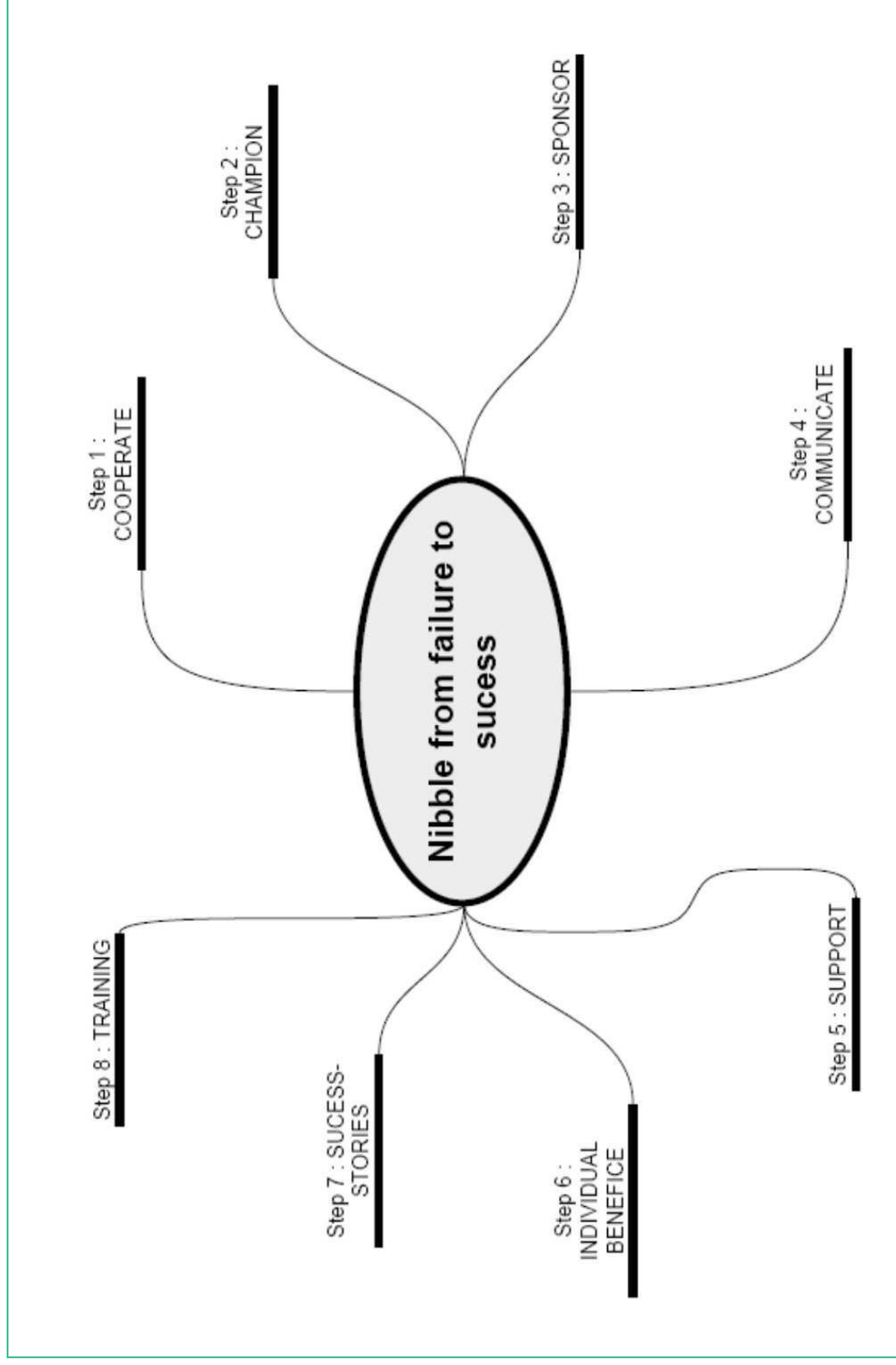


Research Paradigm

Organisational Management Methodology / European Large Bank
Tool for Annotation Management



Nibbling Methodology : MPG



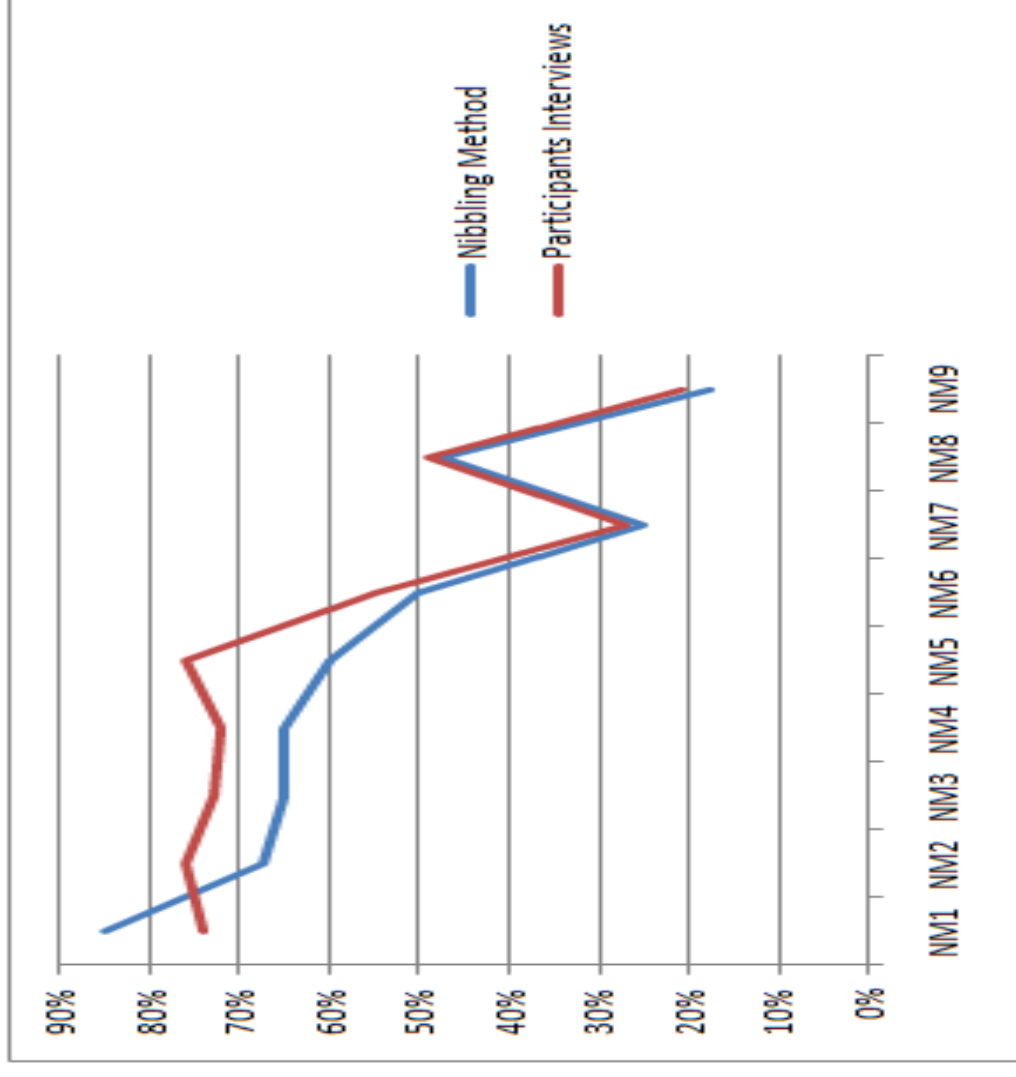
Dashboard

- Tools Experimentations
- CSCW :
 - Netmeeting
 - WSS
 - FacilitatePro



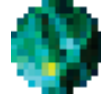
MPG Validation

- Indicators evolution
- A posteriori interviews



MIPG Conclusion

- **EADS Experimentation**
 - **Knowledge Management Tool Designing**



Tool for Annotation Management

- **Health Care Activities**
 - Information Transmission
 - Dynamical Information
 - Mock-Up development
 - Information Co-design
 - Collaborative Tool
- **Multi-View approach**

Annotation Management Tool

The screenshot displays the Annotation Management Tool interface. At the top, there is a toolbar with icons for navigation, text formatting (bold, italic, underline), list creation, and sharing. Below the toolbar, a video player shows a scene with the text "Tom Wujec: Build a tower, build a team" and a timestamp of 0:00 / 7:23. To the right of the video, a patient list is visible, with "Mr. Jean, Henrichon, ne le : 8/20/1960" highlighted. Below the patient list, a timeline is shown with three time points: Time 1, Time 2, and Time 3. Annotations are represented by colored boxes: a pink box for Time 1, a pink box for Time 2, and a green box for Time 3. A mouse cursor is pointing at the Time 2 annotation. The annotations contain text and QR codes. The Time 1 annotation says "Inner annotations can be created through time". The Time 2 annotation says "Inner annotations manipulations are stored thanks to timeline". The Time 3 annotation says "These features allow to build knowledge through time and to store this construction for educational purpose or for posterior analysis."

Annotations are both containers and content objects that can handle *embedded texts*, videos, images, pdf and so on thanks to authorized files extensions rules.

Tom Wujec: Build a tower, build a team

Demonstration of autocomplete feature to access for example a patient:

jean

Patient

- Mr. Martin, Jean, ne le : 4/6/1968
- Mr. Jean, Henrichon, ne le : 8/20/1960**
- Mrs. Inès, St-Jean, ne le : 2/11/1967
- Mr. Jean, Fortier, ne le : 1/1/1992
- Ms. Trinettes, St-Jean, ne le : 9/8/1976
- Ms. Jeannine, Bussière, ne le : 12/16/1933
- Mr. Elisabeth St-Jean, ne le : 7/25/1085

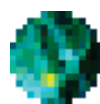
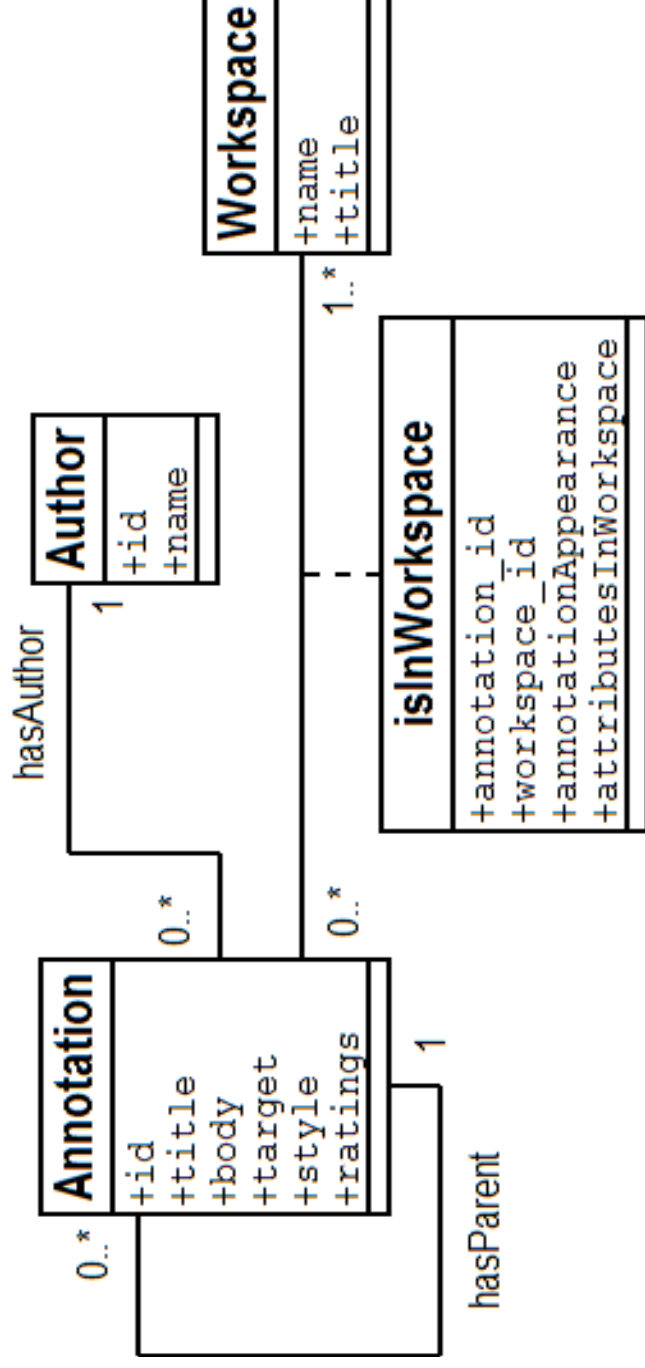
Inner annotations can be created through time

Inner annotations manipulations are stored thanks to timeline

These features allow to build knowledge through time and to store this construction for educational purpose or for posterior analysis.

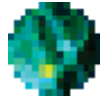
Time 1 Time 2 Time 3

Simplified annotation Class Diagram



Communication Analysis

- Crisis Management : Air Traffic Control Management
- Official experience feedback
- Non-official experience feedback
 - newsgroup between pilots and air-traffic controllers
- Sematic analysis : TermoWeb, TermoStat, Alceste
- Comparison between the two approaches



OENODECISION

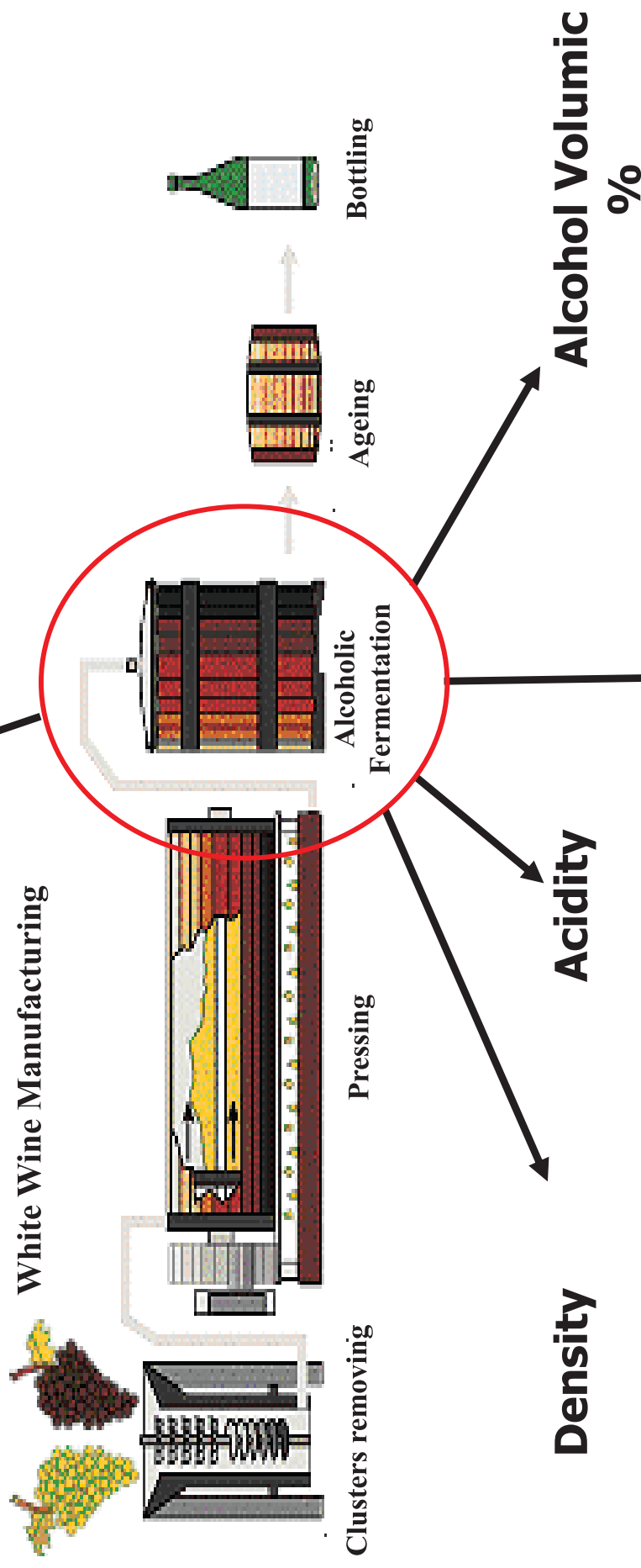
- Alcoholic fermentation dynamical models
- Collaboration LGC – INPT
- 2 models :
 - Ph Calculation
 - Ph dynamical forecasting at delta T

Context and methodology

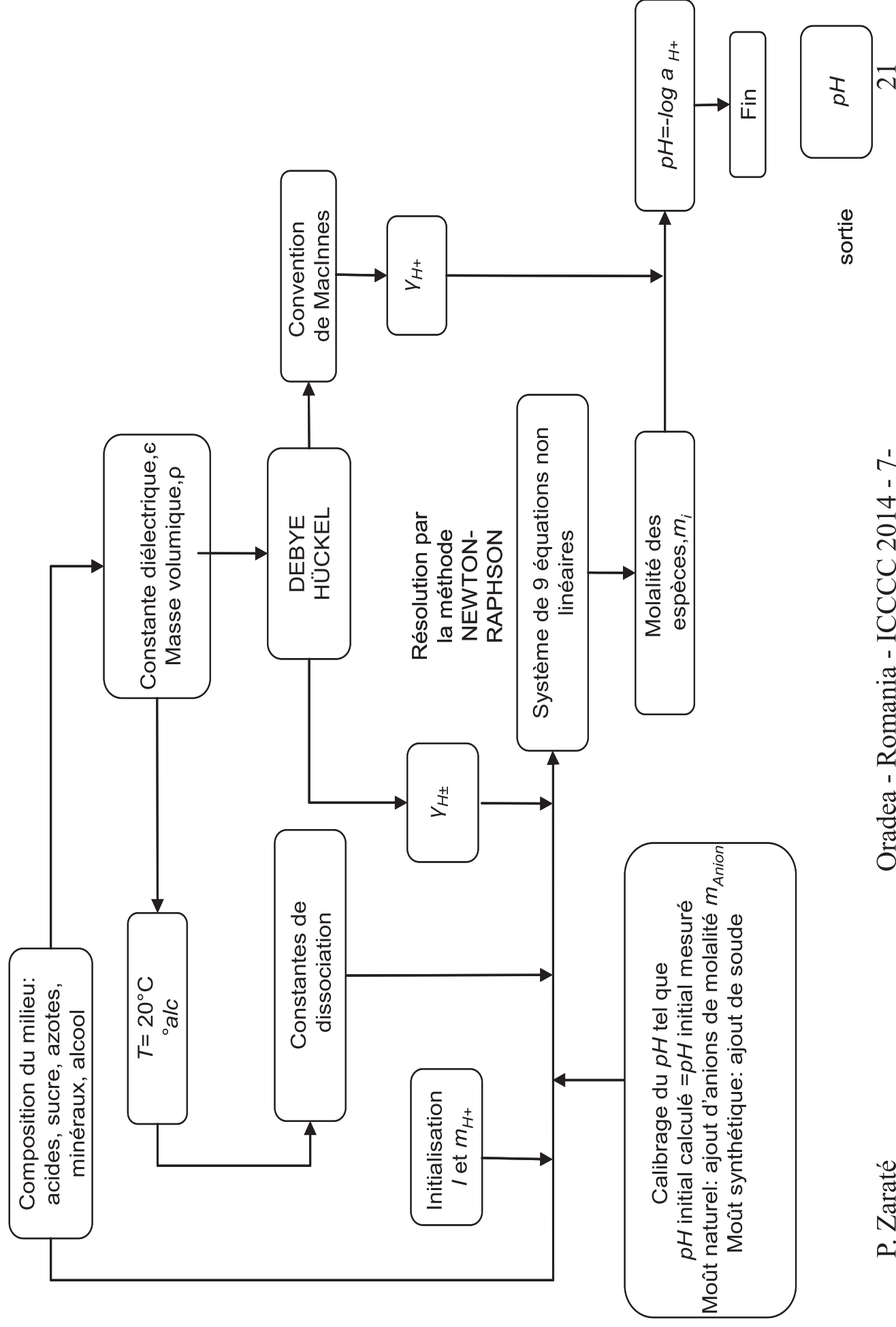
Industrial Process  5 steps

Ethanol, CO₂, Glycerol,
Organic acid, Biomass
et other small members

Must 



Model 1 : Ph Calculating



Model 2 : Ph Evolution

- Reactional function
- Sensibility analysis : sugar, ethanol, Nitrogen, biomass, CO2 et Amino acids

Model 2: Integration of an equations system

Speed explicit variables r1, r2 and r3.

$$\left\{ \begin{array}{l} \frac{dX}{dt} = 5.73 \mu_{\max} \frac{[S]}{[S]+k_2} \frac{[NH_3]}{[NH_3]+k_4} + e.k_3[AA] \\ \frac{dS}{dt} = -k_1[X][S] - \mu_{\max} \frac{[S]}{[S]+k_2} \frac{[NH_3]}{[NH_3]+k_4} - i.k_3[AA] \\ \frac{dEth}{dt} = 2k_1[X][S] \\ \frac{dCO_2}{dt} = 2k_1[X][S] + 0.27 \cdot \mu_{\max} \frac{[S]}{[S]+k_2} \frac{[NH_3]}{[NH_3]+k_4} + gk_3[AA] \\ \frac{dNH_3}{dt} = -1.15\mu_{\max} \frac{[S]}{[S]+k_2} \frac{[NH_3]}{[NH_3]+k_4} + h.k[AA] \\ \frac{dAA}{dt} = -k_3[AA] \end{array} \right.$$

Model 2: Parameters Identification

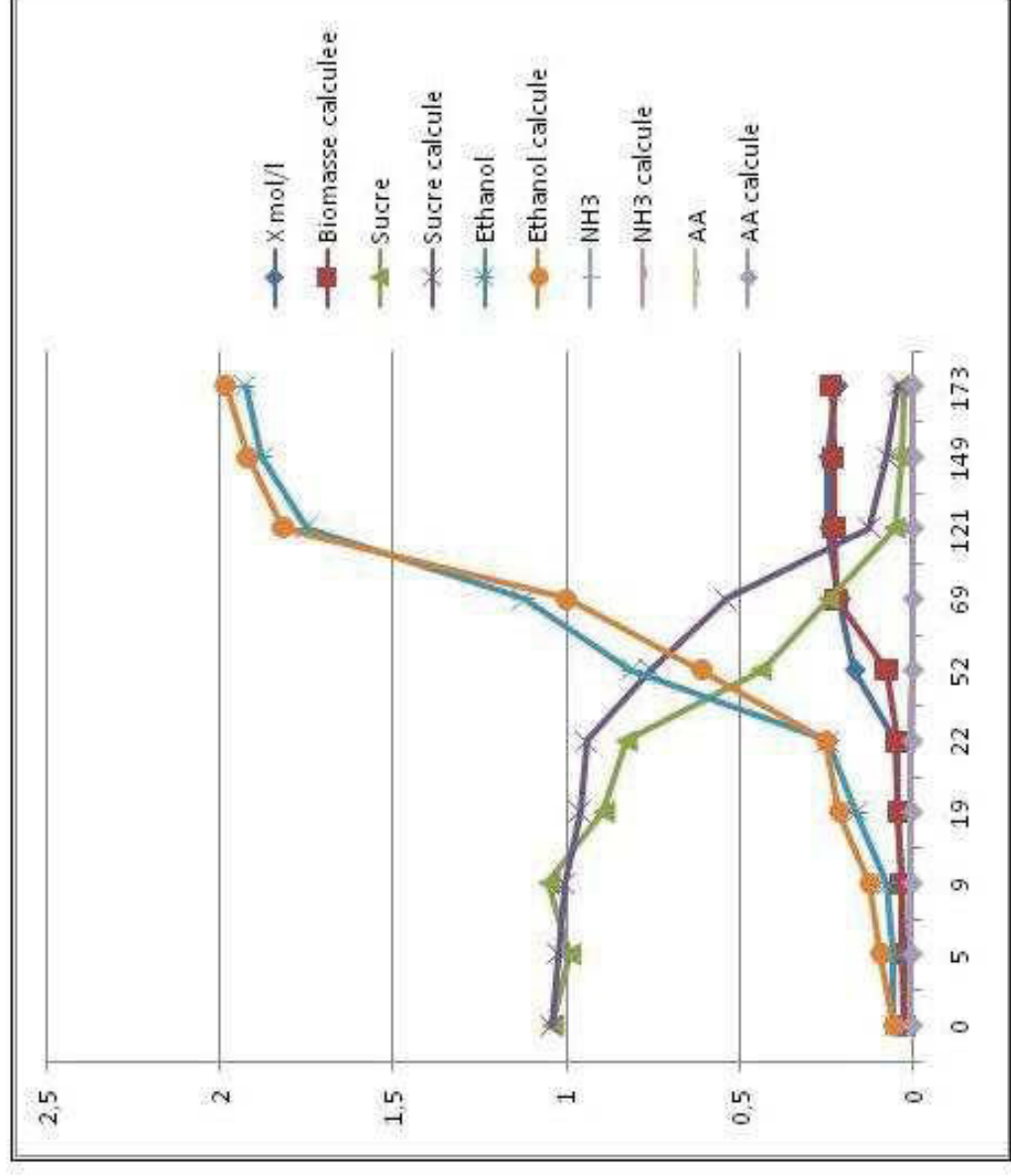
Parameters and stoichiometric coefficients optimization

μ_{max}	0.17
k_1	0.02
k_2	1.06
k_3	0.01
k_4	0.02

f	g	h	i
0.61	2.04	0.01	1.03

Model 2 : Validation

Measured and calculated concentrations comparison



OENODECISION



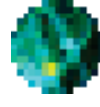
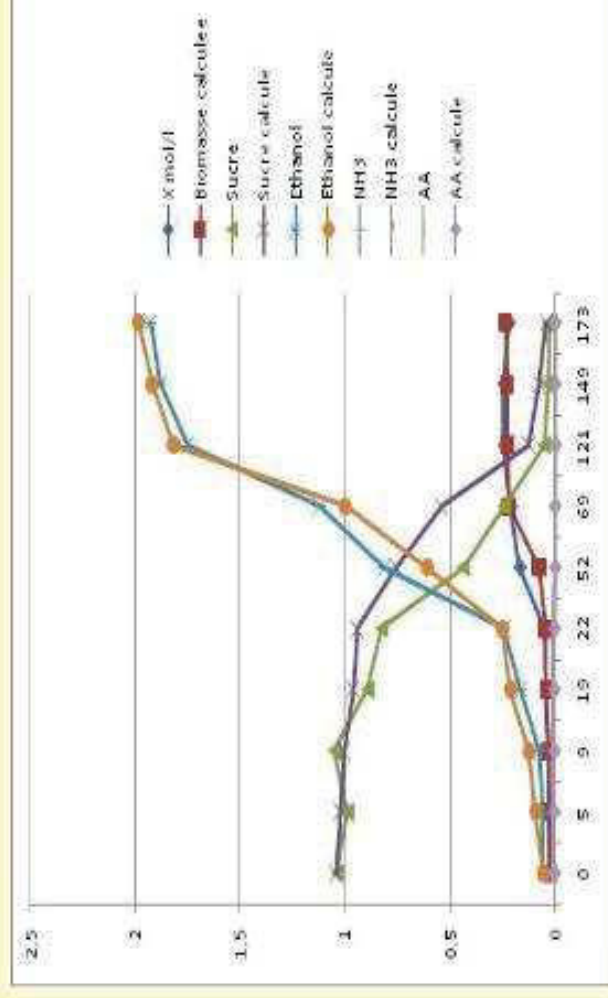
[Inscription](#)

[Identification](#)

[Accueil](#)

[Aide](#)

Simulateur fermentation alcoolique

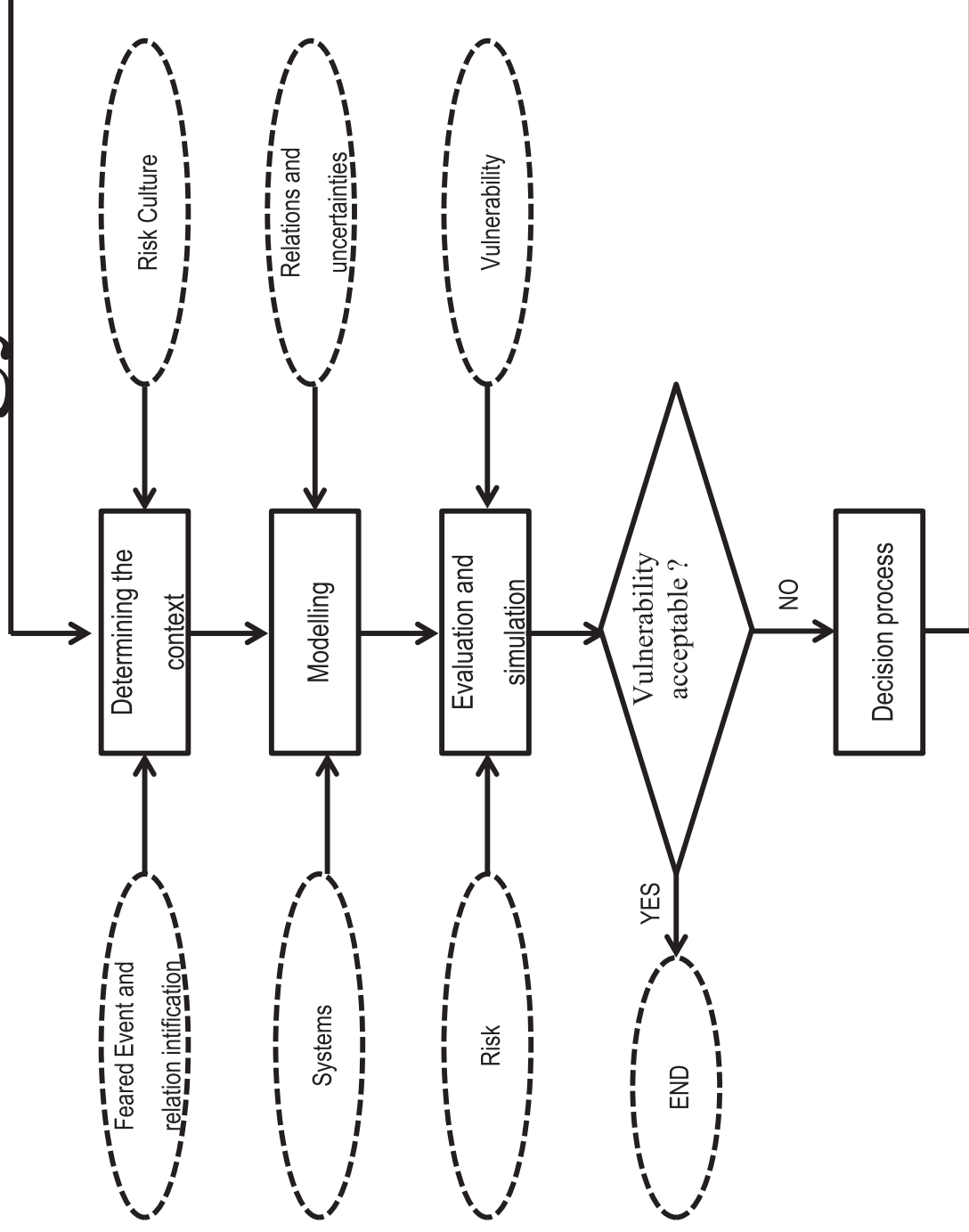


Network Vulnerability Analysis

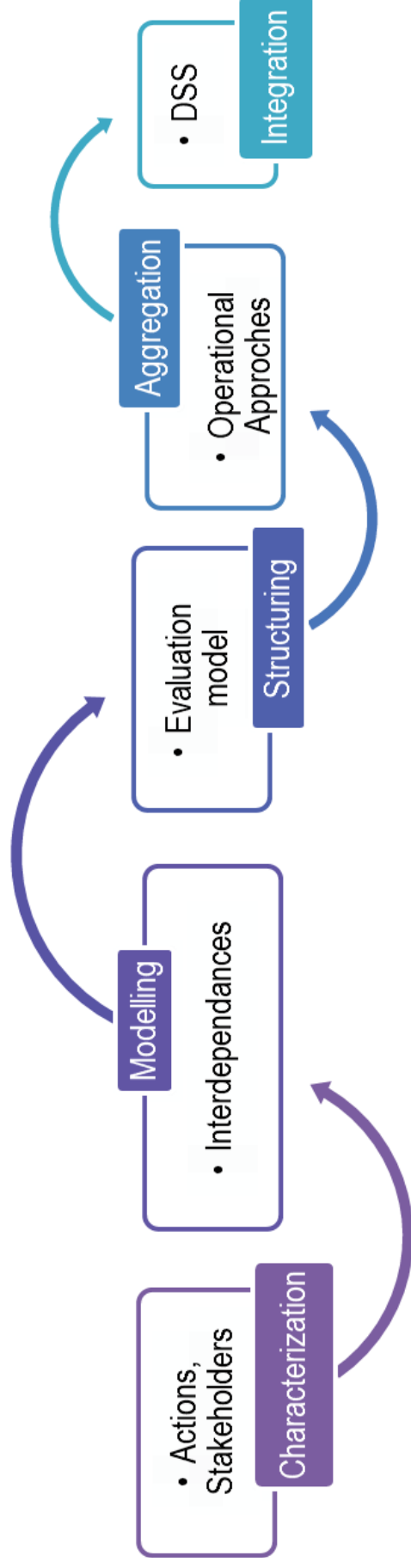
- Model and methodology to analyze interdependent critical systems risk
- Any kinds of networks
 - Electricity network
 - Communication Network
 - ...
- Model of risk analysis based on risk management
- Decision Support for limitation of damages in case of natural disasters

Vulnerability Analysis

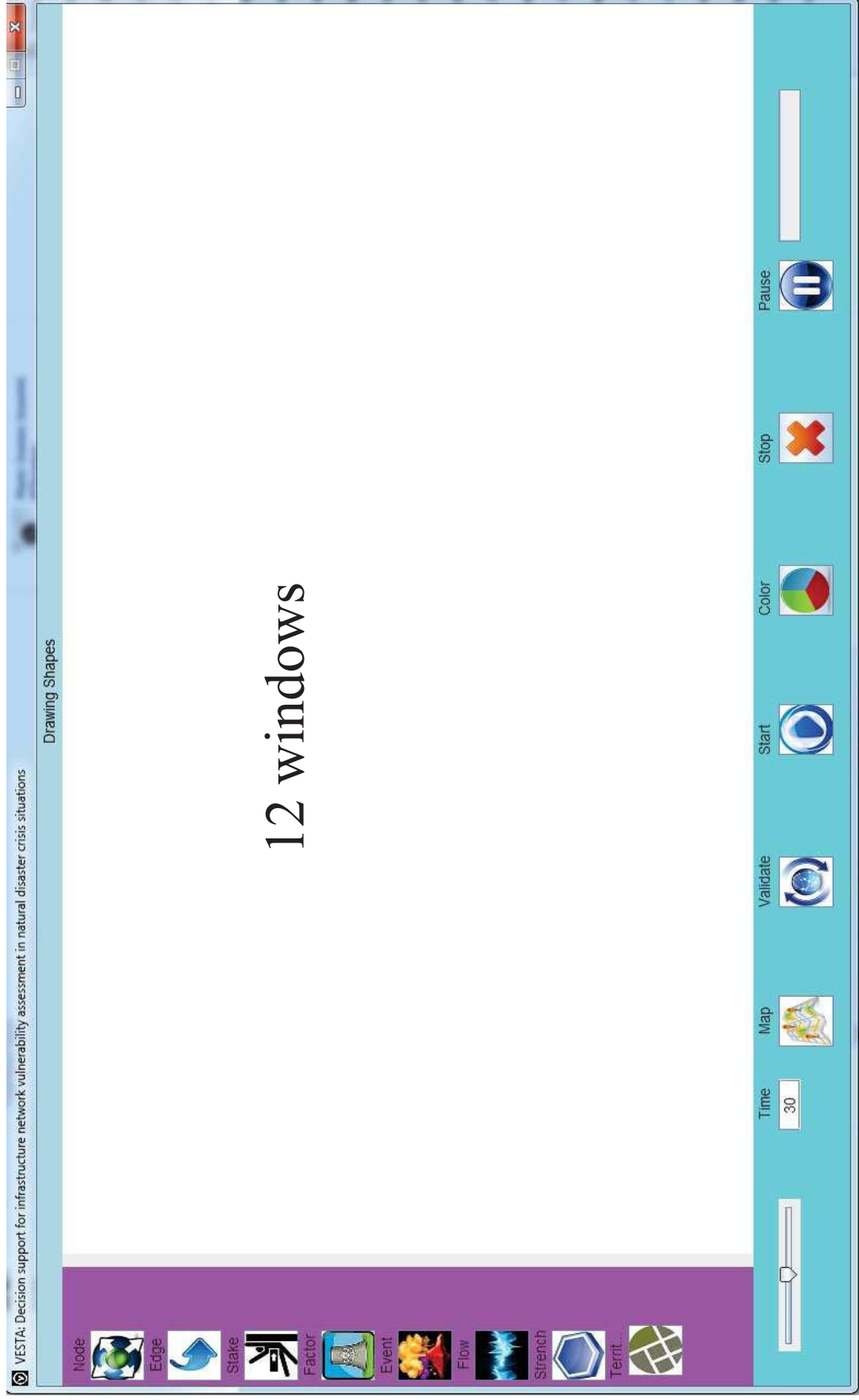
Methodology



Decision Aiding Process



DSS

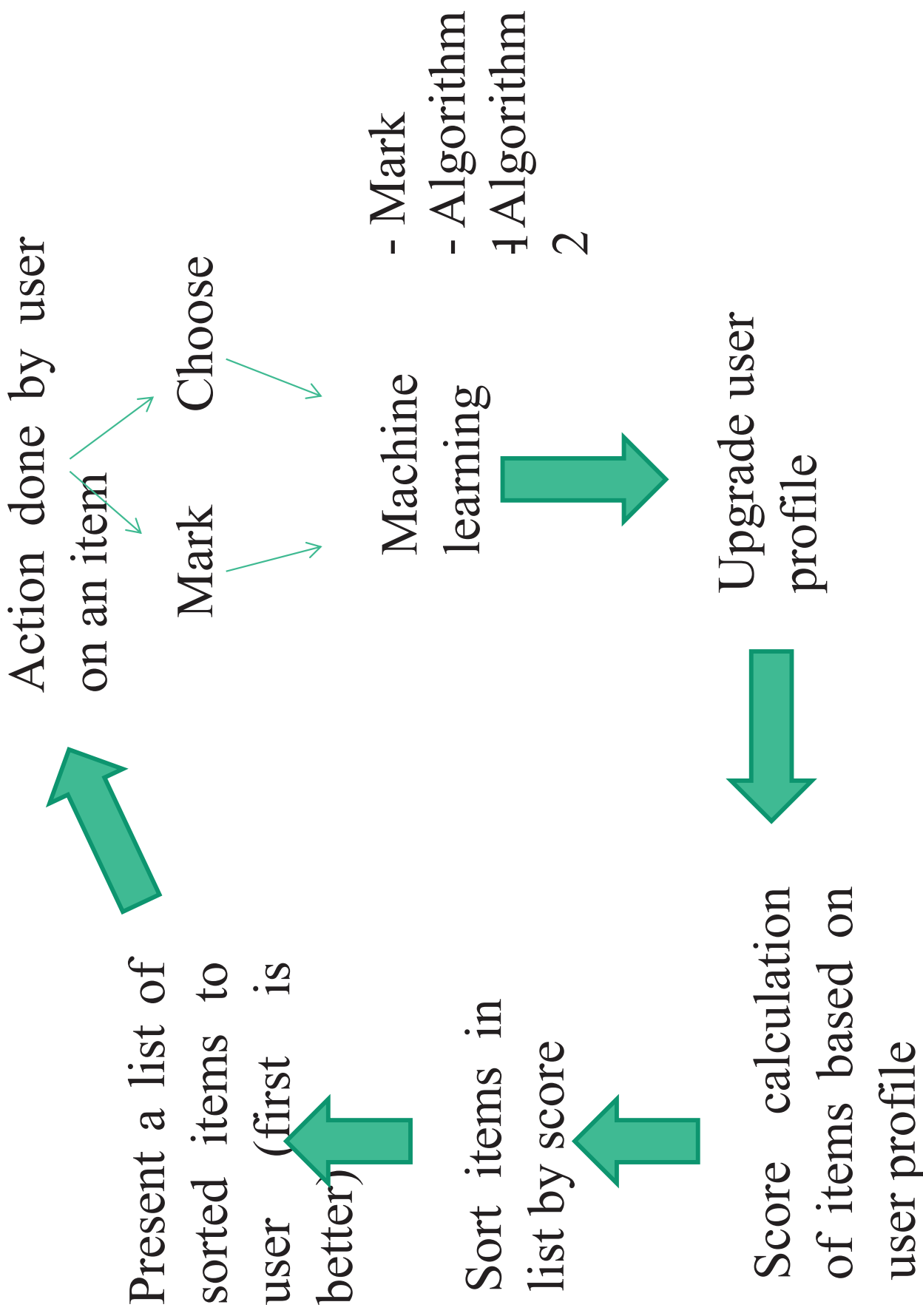


12 windows

Profiling Agent

- Web Marketplace
- Developed approach
 - Reinforcement algorithm : Information Retrieval
 - Scoring : Only Incrementation
- Scientific Bottlenecks
 - Information unaggregation
 - Double automatic learning
 - Actions / Criteria value
 - Criteria weight

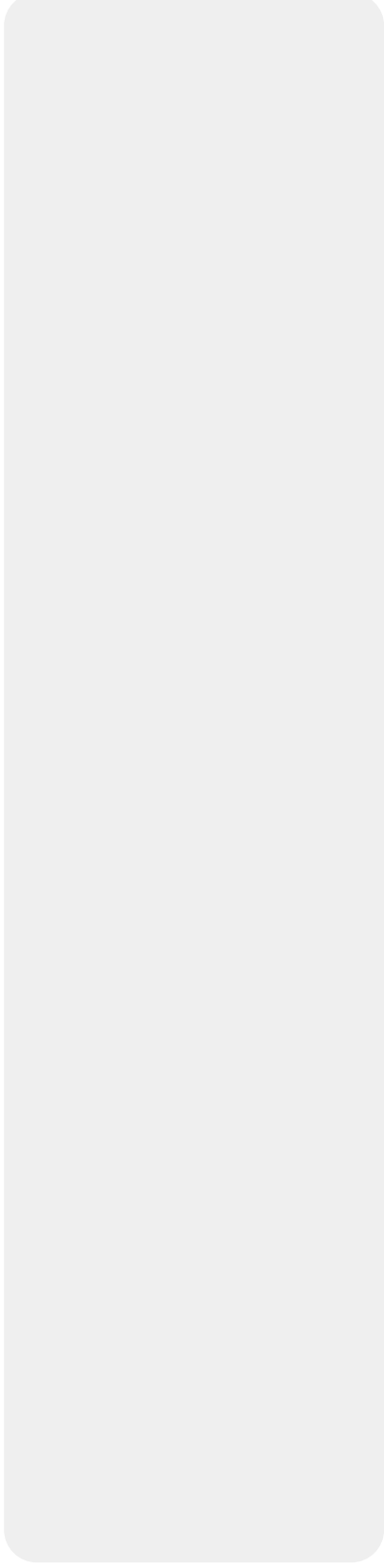
Users' Feedback



Algorithm N°1

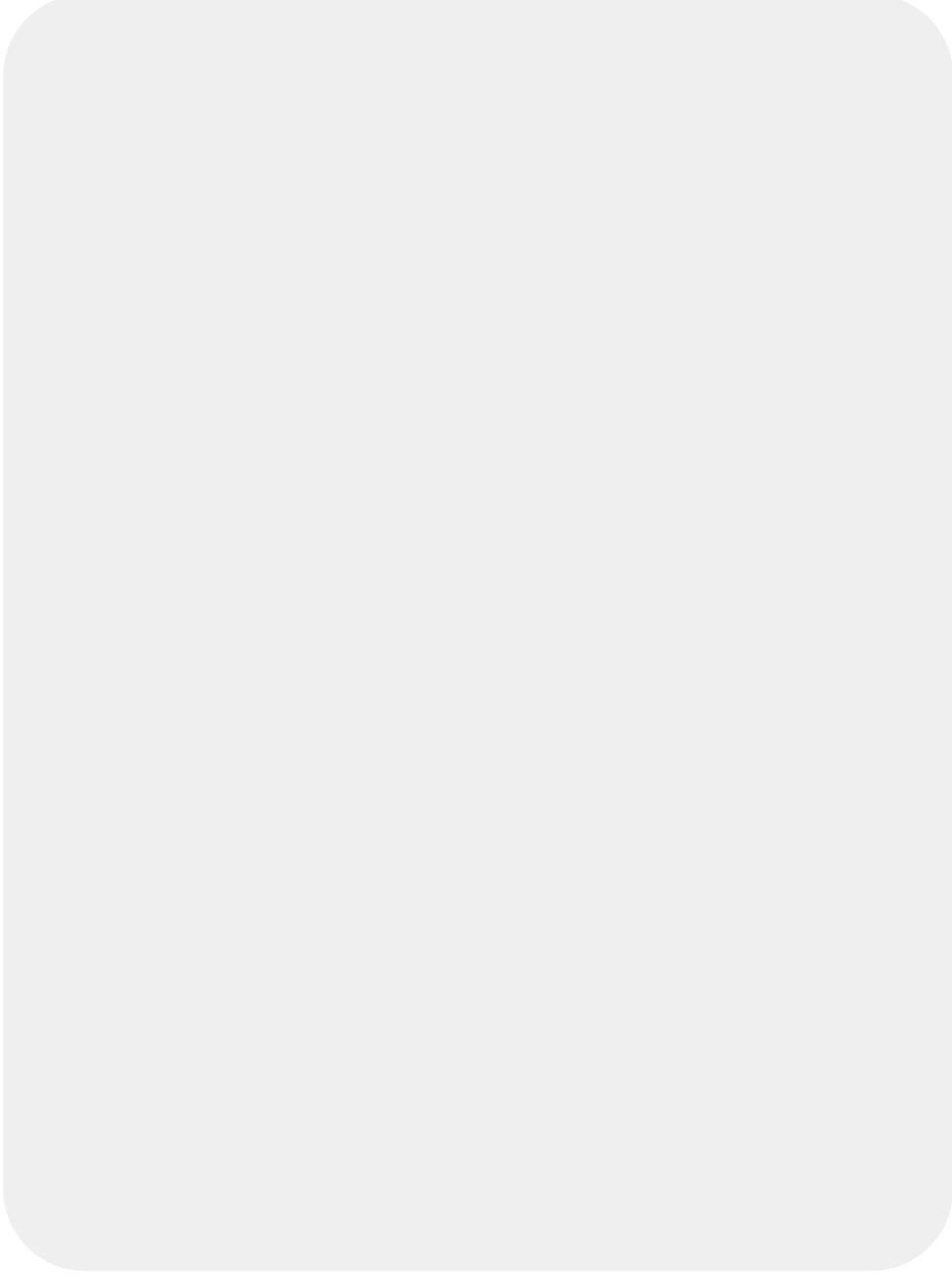
- Initialize temporary vector
- Repartition calculation of current item and upgrade of temporary vector
- Work on the list
- Upgrade of user profile

Upgrade of User profile



- $s(t+1)_i$ corresponds to the score of criterion “i” at time “t+1” in user profile
- $s(t)_i$ corresponds to the score of criterion “i” at time “t” in user profile
- $sc(t)_i$ is the score calculated for the criterion “i” from the current element at time “t”

Repartition calculation

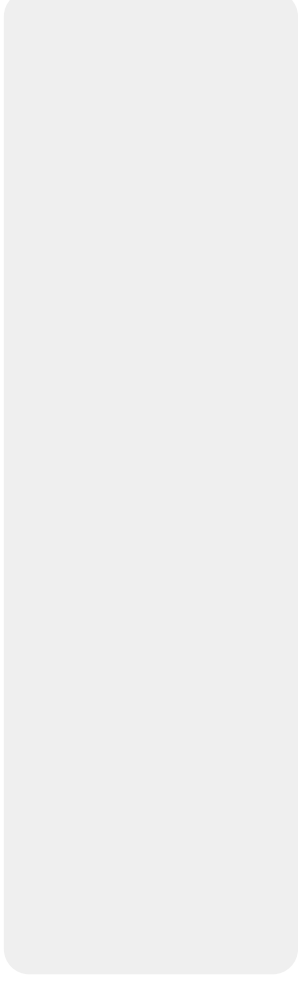


- X = little value to add for that selected item (k) be higher than current (j) (determined depending on the accuracy Delta)
- $sc(t)j$ is the score calculated for the criterion “ j ” from the current element at time “ t ”

Algorithm N°2

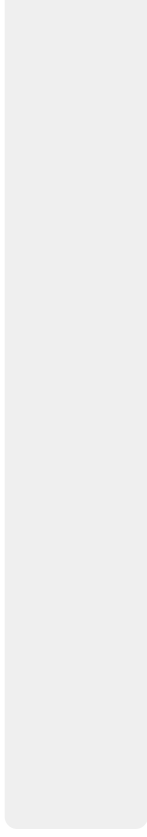
- Initialize temporary vector
- Removing non-discriminating criteria
- Repartition calculation of current item and upgrade of temporary vector
- Work on the list
- Upgrade of user profile

Algorithm N°1 vs. Algorithm N°2



$i = 1$

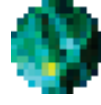
ind i is the index of the selected item in the list of items proposed



Intuitively it would seem that we should use algorithm 1 where the choices are consistent with the profile and the algorithm 2 in the other cases .

Conclusion

- Algorithm able to update users' profiles
- Application to Privacy Data protection for Ambient Systems



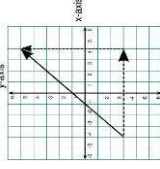














KAPUER

A DSS for protecting Privacy

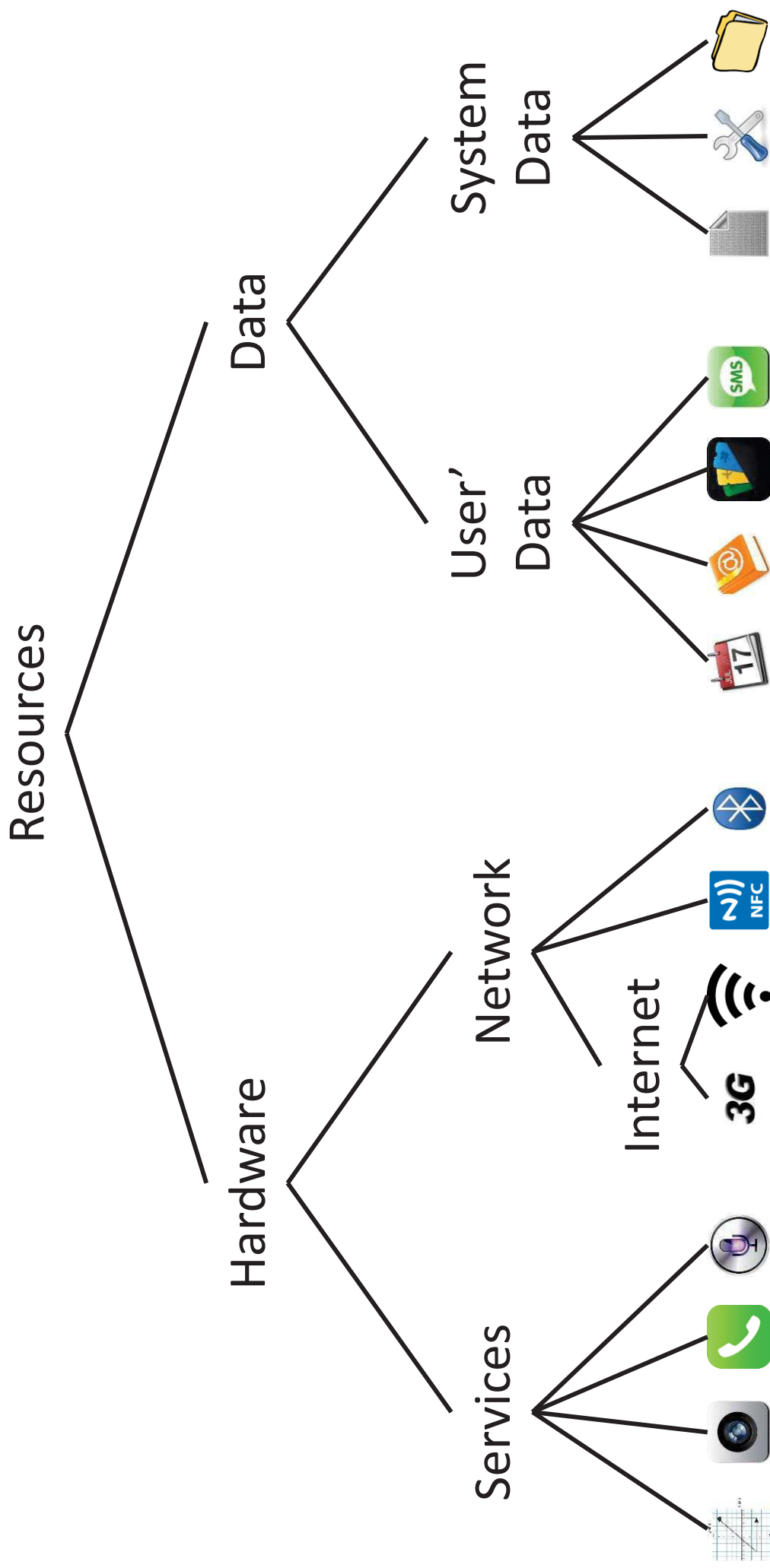
...Grouped in 8 categories

Games	
Social	
Entertainment	
Communication	
Tools	
Gadget	
Music & Audio	
Travels & Information	

15 Sensitive resources...

GPS Position		Camera		Telephon		Audio		Planning	
Address		Account		SMS		3G		Wifi	
NFC		Bluetooth		Log		Parameters		Files	

...Sorted Out



5 actions...

- **Read**
- **Write**
- **Execute**
- **Send**
- **Receive**

...For hundred requests for Sensitive Data!

Escape-The-Titanic Les-Simpson-Springfield Vous-avez-cassé-mon-écran
Log Dragons-World Jelly-Splash
Rescue-Saga Audio Twitter Exécuter
Candy-Crush-Saga Wifi Pou iBière-Gratuite
Calendrier Contact Pages-Jaunes NFC Facebook Téléphone
Bluetooth Instagram Leboncoin SMS Petite-gorge-Médecins
Verrouillage-de-l'écran Viber Compte Kaizin-Rumble France-IV Temple-Run-2
Envoyer Fichier Papa-Pear-Saga Deczer
Doodle-Jump 3G Shazam Pet APN Paramètre
Waze-Social-GPS-Maps Ecrire 6Play Adobe-Reader
Angry-Birds Jeptack-Joyride Coordonnées
Clash-of-Clans Mobile-Security-&-Antivirus Lampe-Torche-LED-HD-Flash

How to protect ourself

- Need to know what we want to do for each resource
- Authorization for each request asks a cognitive workload

How to protect ourself

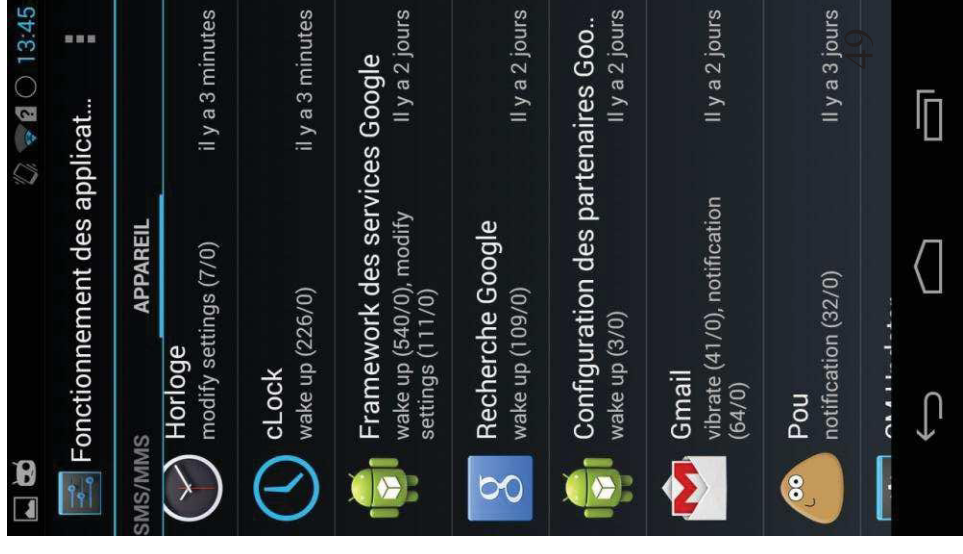
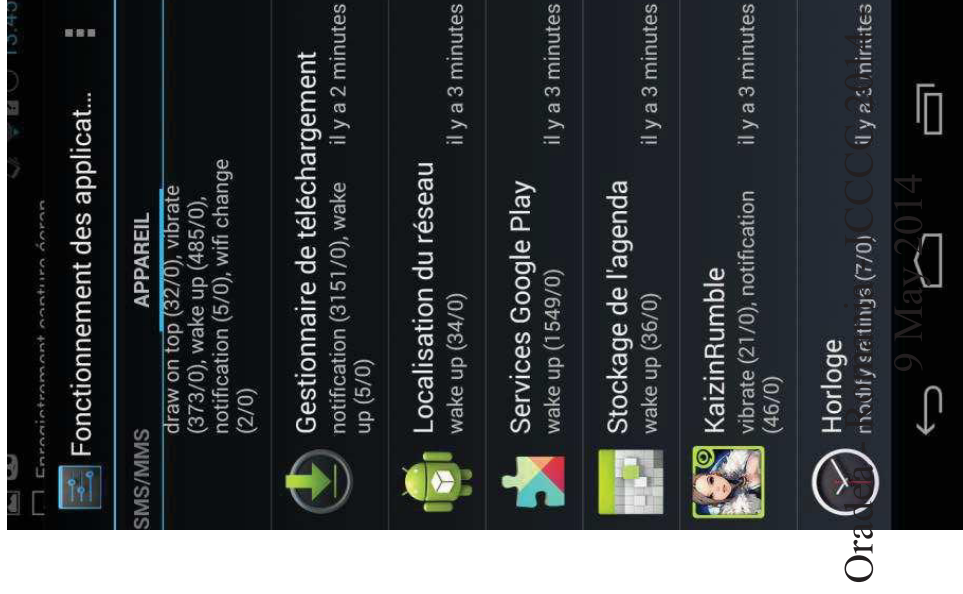
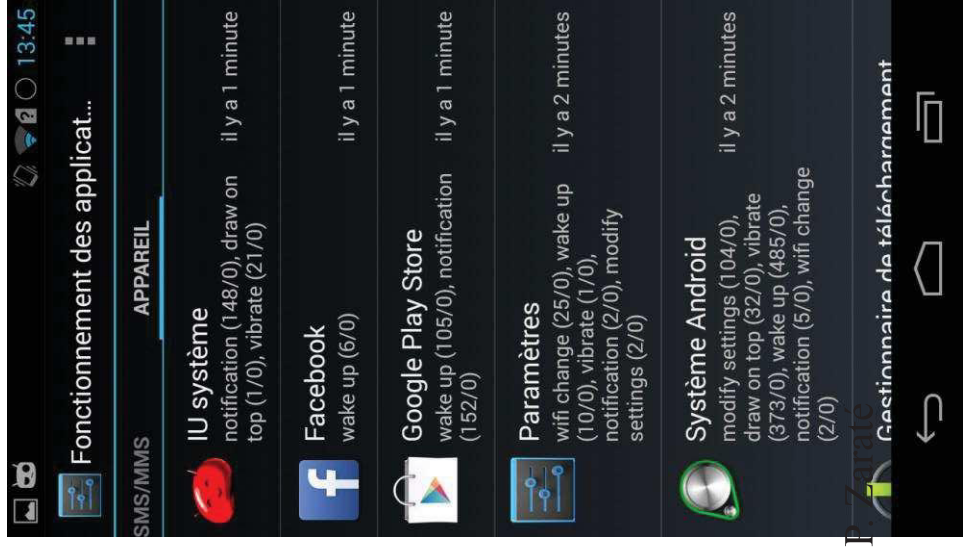
- 3 possible approaches
 - Through a graphical interface
 - Through a parameters file
 - Through Kapuer

Graphical Interface

- Accessible withCyanogenMod ou LBE Privacy Guard
- Allows to manage the authorizations application by application

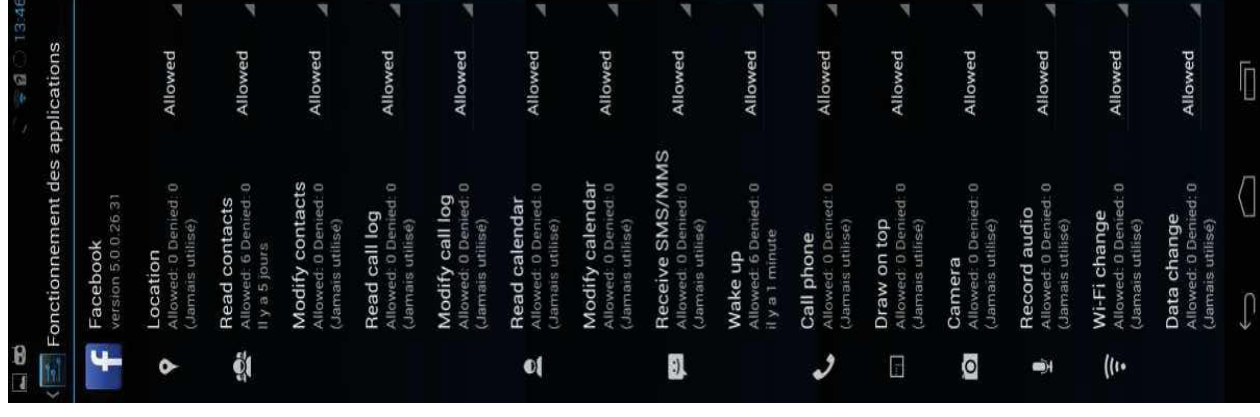
One example : CyanogenMod

- Around 10 pages of application in which user, system and requests are mixed



One example : CyanogenMod

- For each application
 - List of authorizations for the user and the system
 - Need to sort out among these resources
- Impossible to manage group of applications or resources



Parameters File

- Technology used with Linux or Access Control Language (ex: XACML)
- Allows a precise management of resources

One example : XACML

- Writing authorization policies for the management of resources access
- Language based on XML

One example : XACML

- Rule n°1 allows the access to games on Internet, the XACML rule becomes :

```
<Rule RuleId="Rule1" Effect="Permit">
  <Target>
    <Subjects>
      <SubjectMatch MatchId="urn:oasis:names:tc:xacml:1.0:function:string-equal">
        <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#string">Jeux</AttributeValue>
        <ActionAttributeDesignator DataType="http://www.w3.org/2001/XMLSchema#string"
          AttributeId="urn:oasis:names:tc:xacml:1.0:subject:subject-metacriterion"/>
      </SubjectMatch>
    </Subjects>
    <Resources>
      <ResourceMatch MatchId="urn:oasis:names:tc:xacml:1.0:function:string-equal">
        <AttributeValue DataType="http://www.w3.org/2001/XMLSchema#string">Internet</AttributeValue>
        <ActionAttributeDesignator DataType="http://www.w3.org/2001/XMLSchema#string"
          AttributeId="urn:oasis:names:tc:xacml:1.0:resource:resource-metacriterion"/>
      </ResourceMatch>
    </Resources>
    <Actions>
      <AnyAction/>
    </Action>
  </Target>
</Rule>
```

XACML

- Pour se protéger complètement, après avoir réfléchi à toutes les règles, il faut les écrire. Au final 8 règles comme la précédente.
- Peu de difficultés pour quelqu'un connaissant XACML et la sécurité. Mais pour les autres...

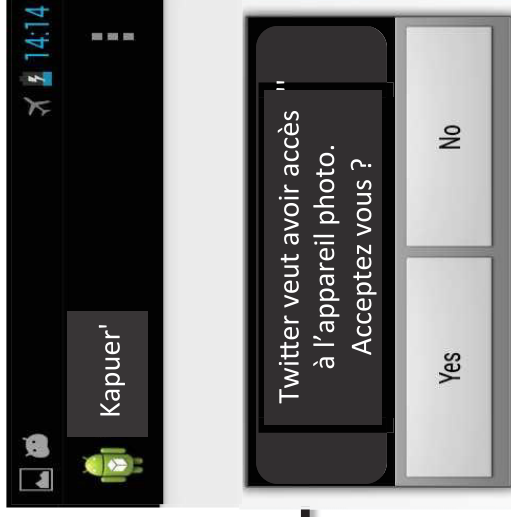
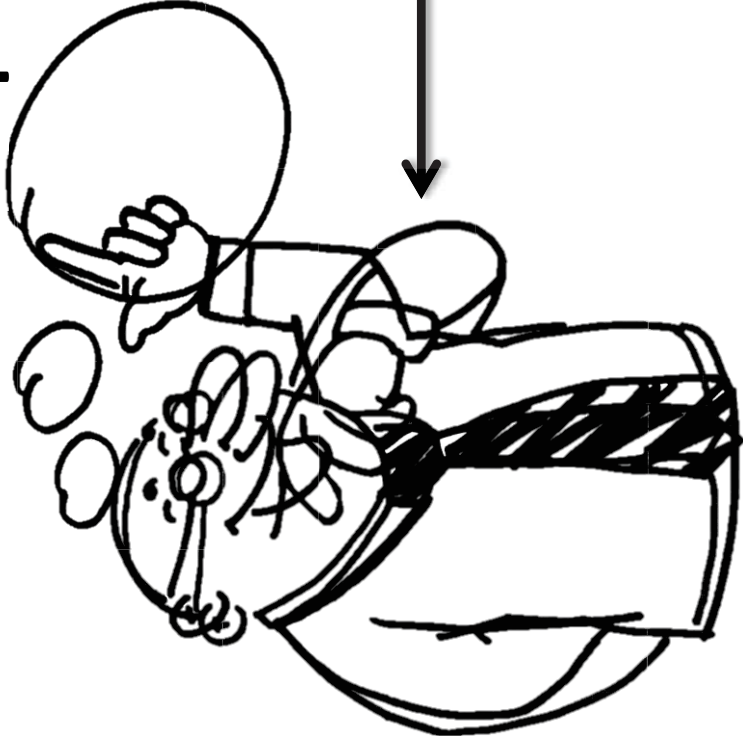
Balance of the 2 first approaches

- Graphical User Interface(GUI)
 - Accessible to everyone
 - Ask a lot of time and a huge cognitive workload to be well protected
 - Fix authorization independant of the use context
- Parameters File
 - Allows to be more precise rather than GUI
 - Asks a huge cognitive workload
 - Requests to know programming language -> Unusable for every users

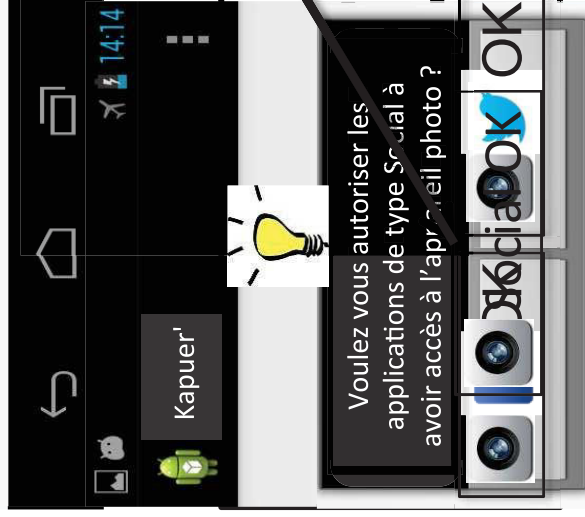
Kapuer

- Advantages of the previous approaches
 - Development of a GUI easy to use
 - Use of XACML for precise rules
- Without the inconveniences
 - No cognitive overload thanks to :
 - User Preferences Learning
 - Decision Made by the user during the application use
 - No need to know programming language

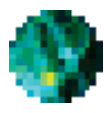
Kapuer : Functioning



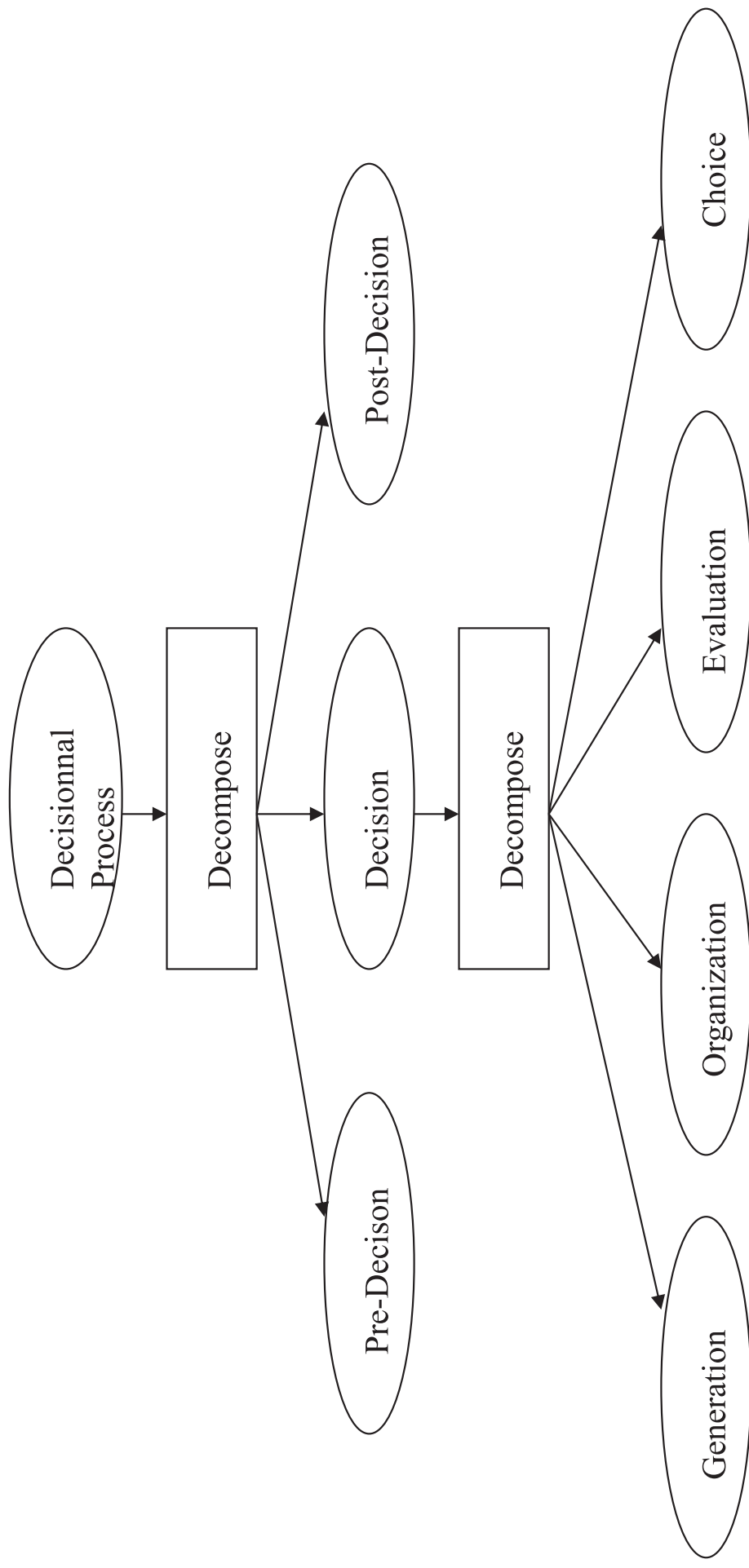
Twitter
Instagram
camera access



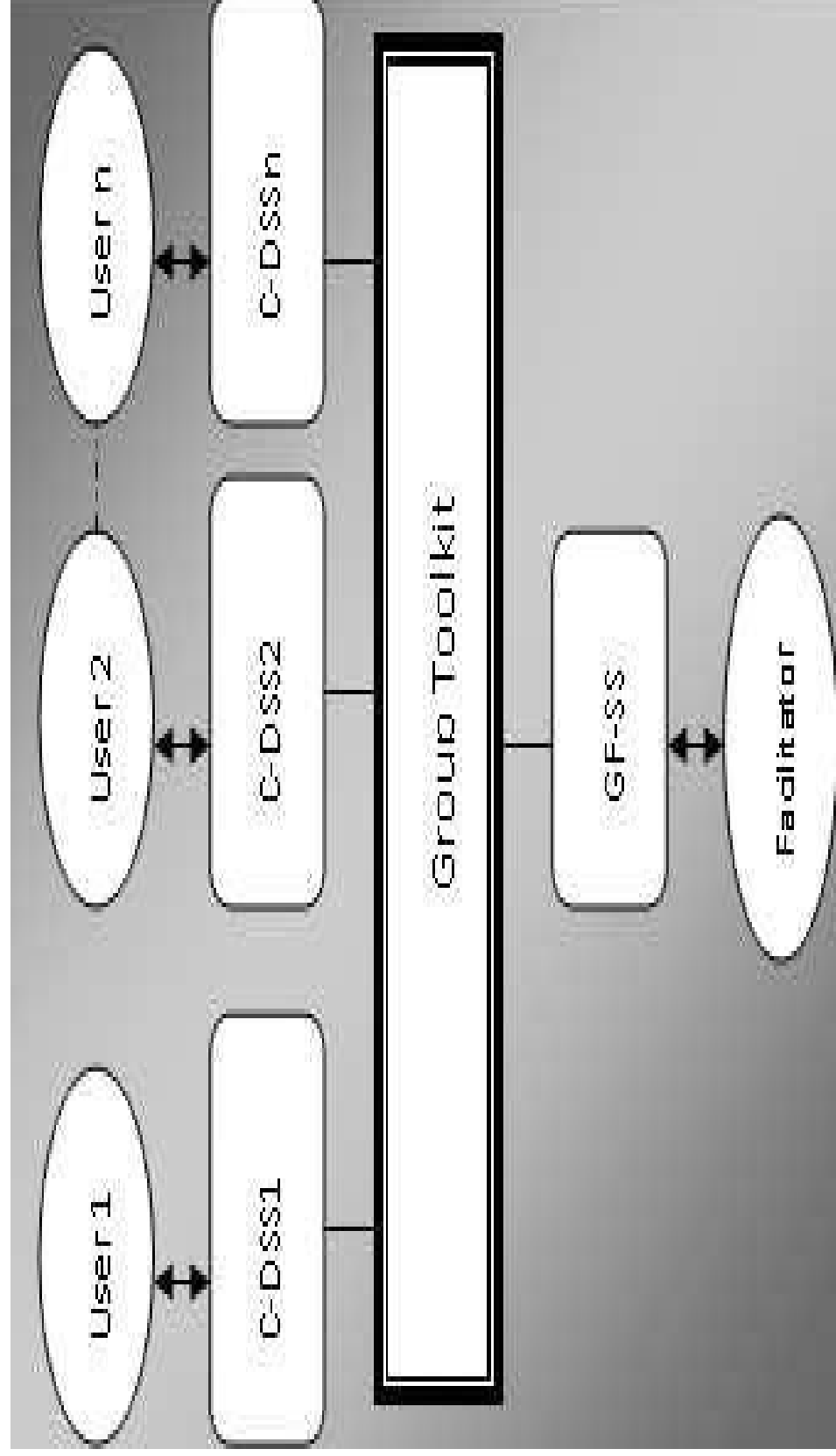
Authorized Access



Group Decision Process

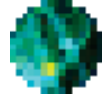


The Framework for Group Decision-Making



Group Decision Process

- Framework developed by parts
- Tools are reusable in different contexts of Group decision Making



Brainstorming Facilitation Support System

- Ideas generation step : Brainstorming
- Designing a brainstorming facilitation support system
- Based on social psychology studies (Osborn, Brown et Paulus)
- Group Decision Making meeting efficiency definition
 - Efficiency estimation
 - Dynamical models use \Rightarrow Production evaluation \Rightarrow Efficiency evolution
- Determine the ideas number and its evolution during a group decision making meeting

Non Cognitive Model

- Weighted sum of previous factors

$$\frac{do_i(t)}{dt} = -a_i o_i(t) - b_i \sum_{j \neq i} o_j(t) + m_i \left[\frac{1}{n-1} \sum_{j \neq i} o_j(t) - o_i(t) \right] \text{ and } o_i(t) \geq 0$$

- $o_i(t)$ is the ideas rate (ideas number per time unit) generated by the participant i ,
- $o_i(t)$ the ideas number rate function,
- a_i the decay rate,
- b_i the blocking rate,
- m_i the tendency to match,
- n the size of the group

Cognitive Model

$$\frac{dg_i(t)}{dt} = -a_i g_i(t) - b_i \sum_{j \neq i} o_j(t), \text{ and } g_i(t) \geq 0$$

$$\frac{ds_i(t)}{dt} = -c_i s_i(t) + g_i(t) - o_i(t), \text{ and } 0 \leq s_i(t) \leq K$$

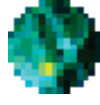
$$\frac{do_i(t)}{dt} = -d_i o_i(t) + r_i s_i(t) - f_i \sum_{j \neq i} o_j(t) + m_i \left[\frac{1}{n-1} \sum_{j \neq i} o_j(t) - o_i(t) \right], \text{ and } o_i(t) \geq 0$$

with

- $g_i(t)$ describes the rate of generated ideas by the participant i over time,
- a_i is the decay rate,
- b_i is the blocking rate,
- $s_i(t)$ is the number of ideas in the short-term memory,
- c_i is the forget rate,
- $o_i(t)$ is the ideas rate which decay at the rate d_i ; f_i and m_i are respectively the blocking and the matching influences,
- r_i , represents the rate of ideas extracted from the memory.

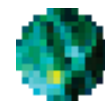
Brainstorming Facilitation

- Approach to find parameters of dynamic model of brainstorming based on Euler and fourth order Runge-Kutta
- Fourth order Runge-Kutta model be used for small group
- Validation of the method/model(s)
 - Test dynamic models and optimization problems on real brainstorming
 - Integrate models obtained by optimization to our efficiency measure



Collaboration Tools

- Group Decision Making Process
 - Pre-decision
 - Decision
 - Post-decision
- CSCW Existing Tools analysis

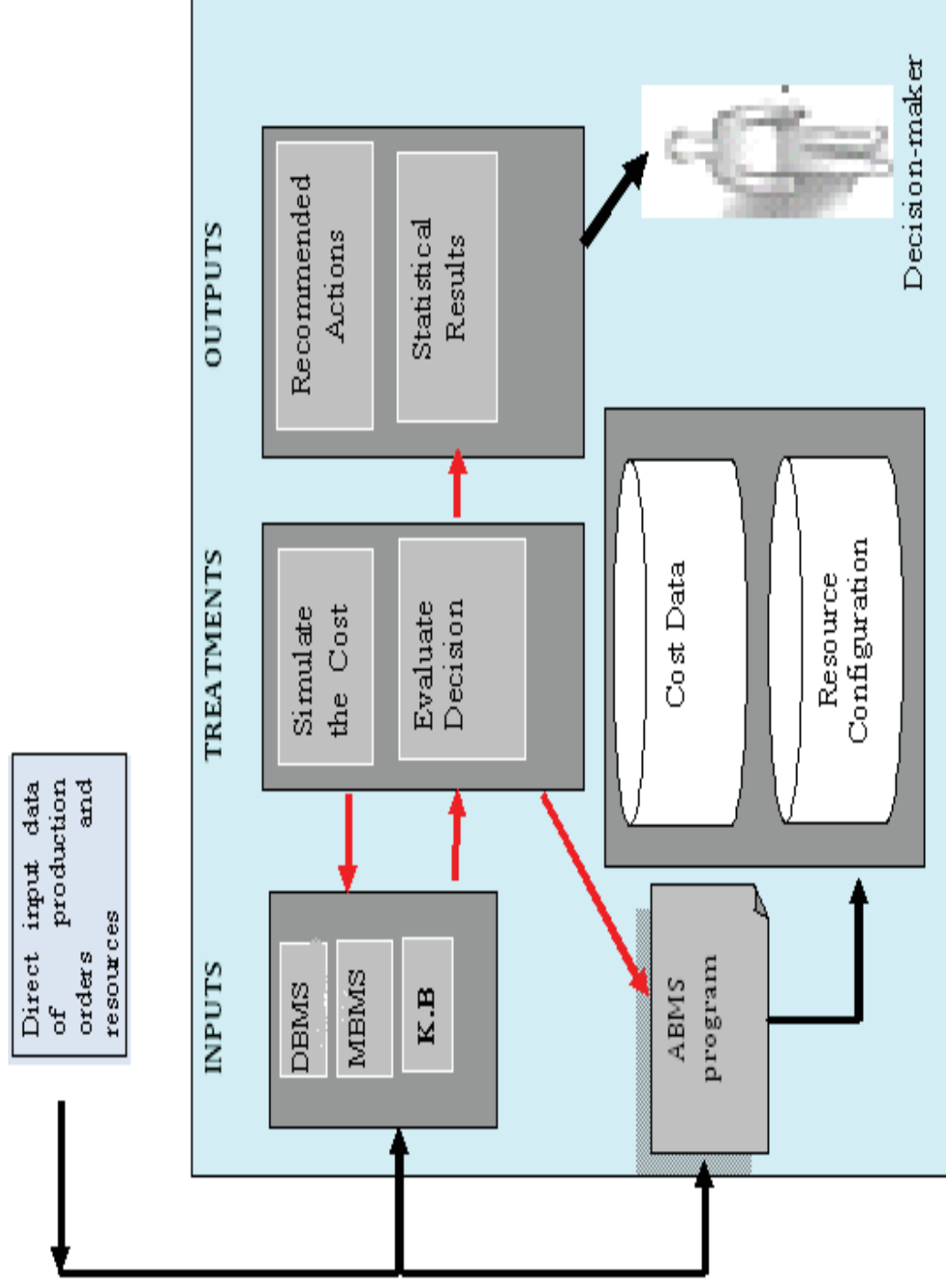


Decision Monitoring	.	+	+	+	+	+	.	.	+	.	.	+	+	+
Documenting	.	+	+	+	+	+	.	.	+	.	+	+	+	+
Actions planning	:	+	+	+	:	+	:	.	+	:	+	+	:	+
Results Analysis	.	+	+	+	.	+	.	:	+	:	+	+	+	+
Prioritizing/ Voting	+	+	+	+	+	+	.	:	+	.	:	+	+	+
Organization	.	+	+	+	+	+	.	.	+	.	+	+	:	+
Brainstorming	+	+	+	+	+	+	+	+	+	+	+	+	:	+
Electronic Invitation	+	+	+	+	+	+	+	+	+	+	+	+	:	+
Agenda Builder	:	+	+	+	:	.	:	.	+	:	.	+	:	+
Anonymity	:	+	.	+	:	.	.	:	+	:	:	+	:	+
Organisational Memory	.	+	.	+	.	+	.	.	+
Time Management	:	.	.	.	:	.	:	:	.	:	:	++	:	.
Functionalities Tools														
Dialogr														
FacilitatePro														
Kindling														
ThinkTank														
Ideascale														
Brightidea														
JamespotPro														
Campfire														
Webcouncil														
BrainReactions														
CentralDesktop														
MeetingWorks														
ExpertChoice														
Grouputer														

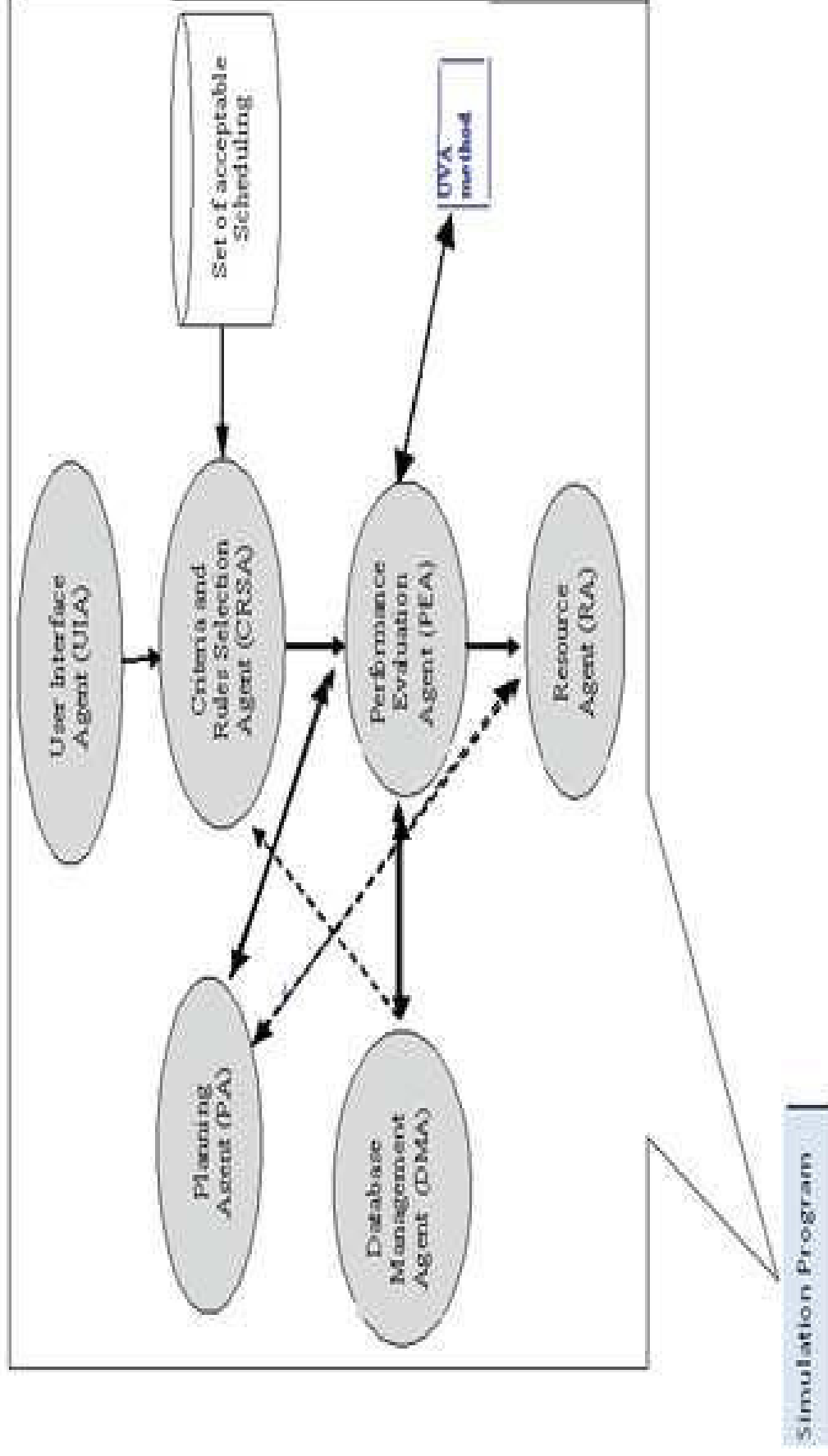
Multi-Agents Negotiation Protocol

- Incidents Management for Production Management
- Multi-Agents negotiation protocol for tasks re-assignment
- Agents : Decision made thanks to the UVA cost calculation methodology
- JADE Plateform

Proposed Model



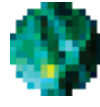
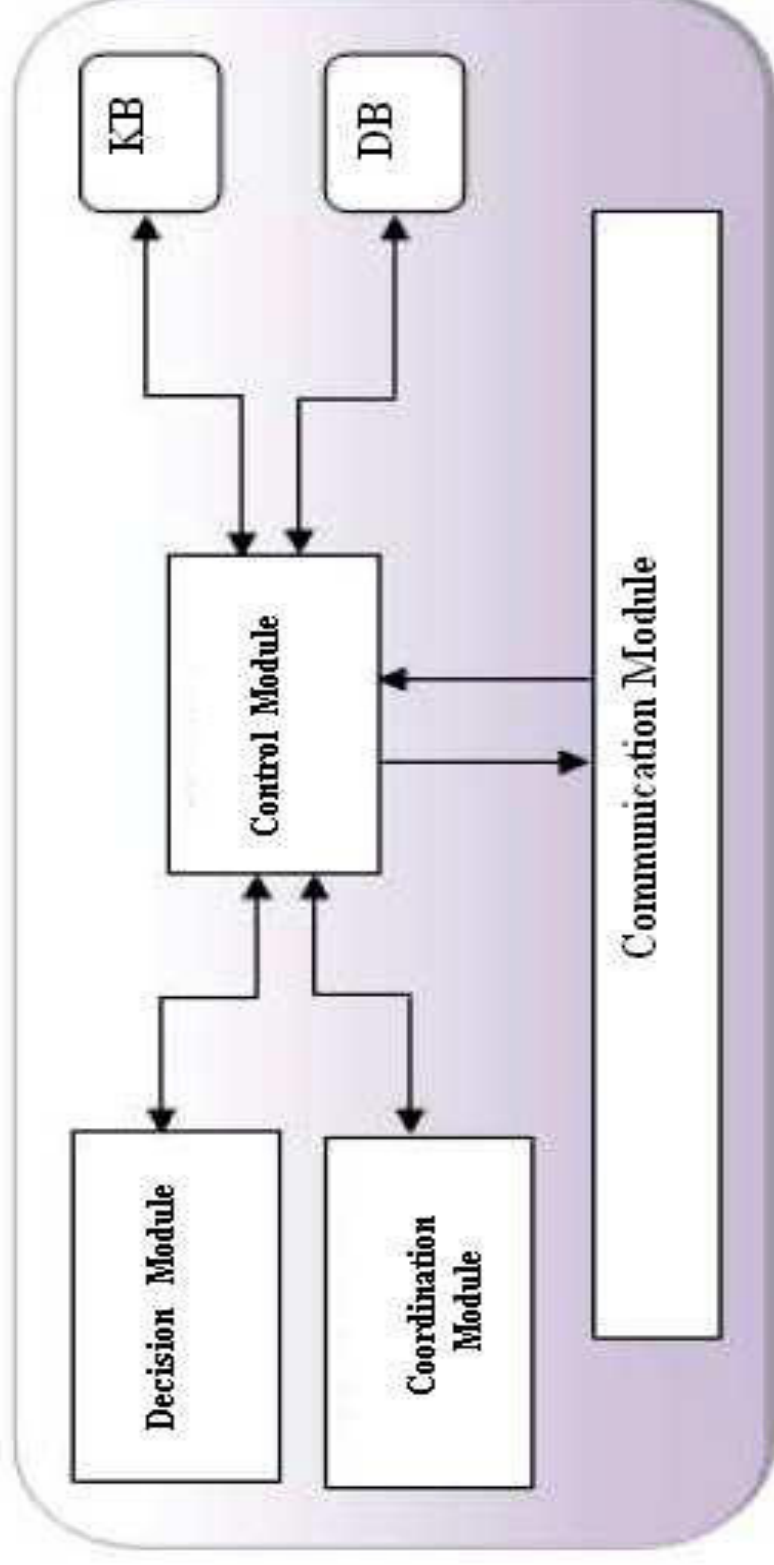
Multi-Agent Production Management System



Coordination protocol for a planning agent

```
Begin
  Var j, i, n : integer;
  Var OK: boolean;
  Var Timemax, PA (Coordinator_Agent), H: string;
  T [Ri](**Ti :ate**), D [Ri] = Array [R1...R2] of String (**Diagnosis state**)
Repeat
  Read (n);
  Read (T [R1]);
  For i := 1 to n do
    Begin
      Read T [Ri];
      if T [Ri] > Timemax then R1 ← Ri
    End
    Grant the request from the agent responsible of R1;
    Goto protocol given in figure 4;
    N ← n-1;
    For i := 1 to n do
      Begin
        Read T [Ri];
        j:=i+1;
        If T [Ri] = T [Rj] then
          Begin
            If D [Ri] ∈ {H} then OK ← Vrai
              CA ← Ri;
            Goto protocol given in figure 4;
          else
            if D [Rj] ∈ {H} then OK ← Vrai
              n ← n-1;
            else
              if D [Rj] and D [Rj] ∉ {H} then OK ← False
                CA ← choose a resource randomly;
                Goto protocol given in figure 4;
                n ← n-1;
            End
          End
        Until system terminated or (n=1);
      End
    End
```

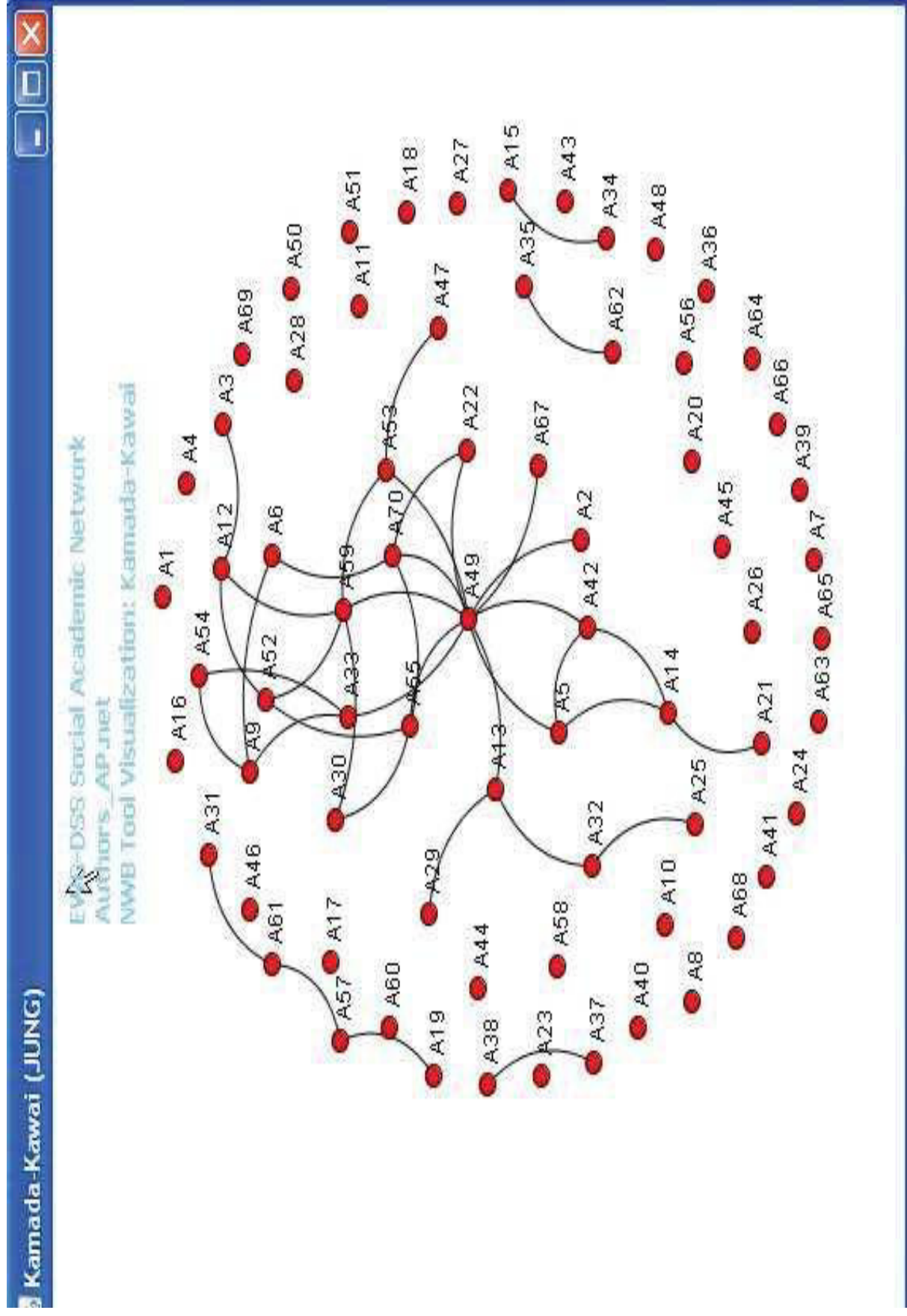
Planning Agent Structure



Social Networks

- Upstream step the group decision making process
 - Actors selection
 - Networks – Coalitions Detection/Visualisation
- Facilitation Support
- EWGDSS Social Network Analysis
 - 1350 publications
 - 70 researchers
 - Collaborations

1st result



EURO Working on DSS



- Since 1989
 - 150 members
 - Board : 6 persons since 2010
- 1 or 2 meetings /year : workshops
 - Special Issues : IJDSST, JDS, EJOR,...

EURO Working on DSS

- Instruments
 - Official EURO Web Site
 - <http://www.euro-online.org/web/ewg/10/ewg-decision-support-systems>
 - EWG-DSS – Blog
 - <http://ewgdss.wordpress.com/>
 - Mailing List : ewg-dss@irit.fr
 - Slideshare Account
 - 1 Newsletter edited / year



EURO Working on DSS



- Next meeting : GDN 2014, Toulouse, France June 10th-13th 2014

<http://www.irit.fr/gdn2014>



Conclusion

- Descendant Solving
 - Dynamical Models
 - Forecast
 - Tasks / Users / Cooperation
- Ascending Solving
 - Multi-agents coordination protocol
 - Social Network detection
- A-descendant approach

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Thank you !

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