

# The Co-Extra Decision Support System: A Model-Based Integration of Project Results

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# WP7 Objectives

WP7: Integration with respect to legal, scientific, social and ethical issues

#### Legal Issues

An overview of the work of all WPs to ensure understanding and compliance with relevant guidance, national and EU legislation.

Integration of results in initial decision support systems for stakeholder, J.J. different supply chains

issues arising from obexistence, traceability and around the world iability.

Legal, technical and political Compatibility of traceability and co-existence systems

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# Co-Extra Decision Support System (DSS)

• Starting point: Considerable scientific results of Co-Extra: data, findings, models, methods, knowledge, ...

- Main idea: Integrate (some) Co-Extra project results in a computer-based information system, which:
  - is operational
  - potentially useful for various categories of users
  - provides data and advice for various decision problems that occur in supply chains involving GMOs









# Typical Decision Questions

- 1. Will my (intermediary) product, given a current set of used procedures and materials, contain GMOs below a specified threshold level?
- 2. Is there any possibility that my (intermediary) product contains unapproved GMOs?
- 3. Which methods perform best or can be used at all for a given analytical or sampling purpose?
- 4. What are the costs associated with maintaining GMO content below some specified threshold?







#### **Potential Users**

- EU policy makers
- farmers,
- importers, transporters,
- feed/food producers,
- retailers,
- consumers,
- analytical laboratories,
- users of test reports from analytical laboratories,
- operators and managers of official control
- •









#### Restrictions

- 1. Focus on producers as primary stakeholders
- 2. Focus on the French maize starch production chain
- 3. Focus on the European situation
- 4. Build on the modular DSS approach that has been developed in the SIGMEA project for co-existence issues
- Develop an initial (prototype) system that is modular and flexible, facilitate its further growth and gradual improvement
- 6. Consult experts to fill in gaps in published data
- 7. Develop a basically qualitative DSS with only quantitative output only where it is feasible







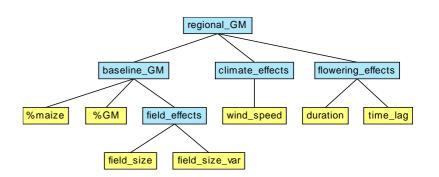


#### Co-Extra DSS Approach

#### Methodology

- Model-Based DSS
  - Qualitative Multi-Attribute Models
  - Decision Trees
- Data-Based DSS
- With elements of:
  - Simulation methods
  - Data analysis
  - Communication-Based DSS

# Starch Feed Output Silo process control parameter Farming input



#### **Expert Modelling**

- Decision Analysts: IJS (Marko Bohanec, Martin Žnidaršič)
- Consulting other Co-Extra partners experts
- Creating models: knowledge representation & problem solving

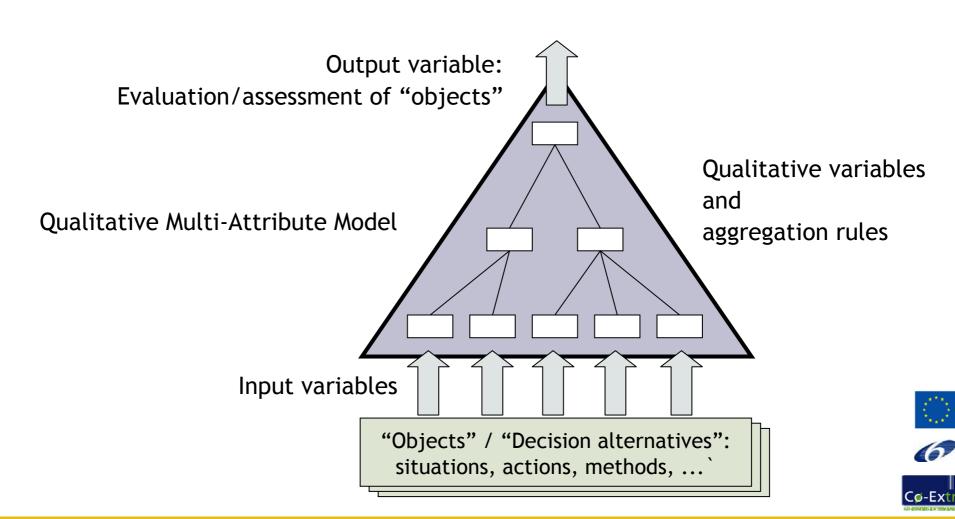






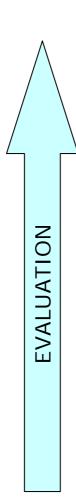


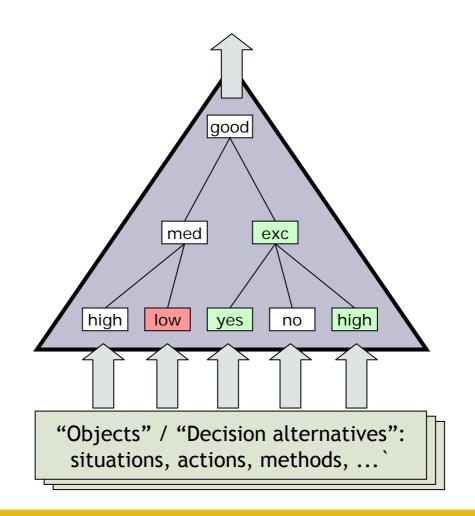
#### Qualitative Multi-Attribute Modeling





#### Using Qualitative Multi-Attribute Models





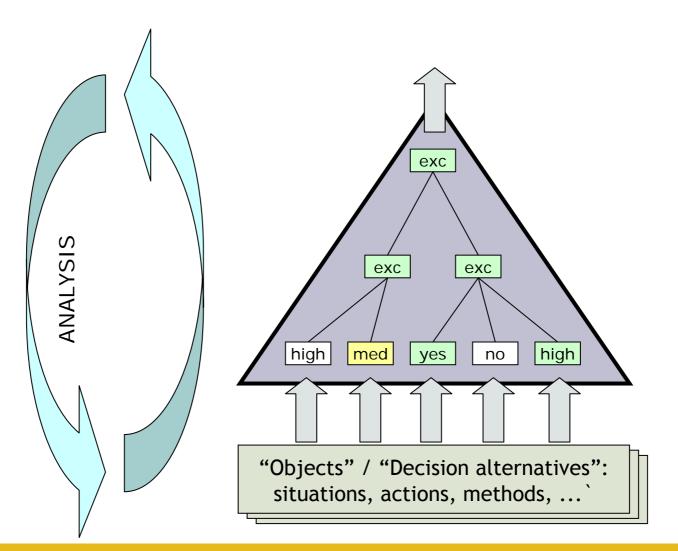








## Using Qualitative Multi-Attribute Models











#### Qualitative Multi-Attribute Models

#### Development

- Expert modelling
- Collaboration of decision analysts and experts
- ► 'Hand-crafting' model structure and decision rules

#### **Purpose**

- ► To capture and represent expert knowledge, which can be reviewed, published, discussed, communicated, ...
- ► To actively assess and evaluate decision alternatives
- ➤ To analyze these alternatives using decision-analysis tools: advantages/disadvantages of alternatives, "what-if" and sensitivity analysis, ...









# Co-Extra DSS Components

#### Models

► Analytical Model: assessment of analytical methods: DNA extraction and DNA analysis methods

K. Gruden

- ► Sampling Model: assessment of sampling plans
- Unapproved GMO Model: assessing the risk of contamination with unauthorized GMO varieties based on traceability data
- ► Transportation Model: assessing potential GMO presence due to transportation and handling based on product traceability data
- ▶ Dryer and Starch Models: assessing the effect of control parameters (such as using different strategies for handling GMO and non-GMO batches) on the collection and processing of maize

#### Data base

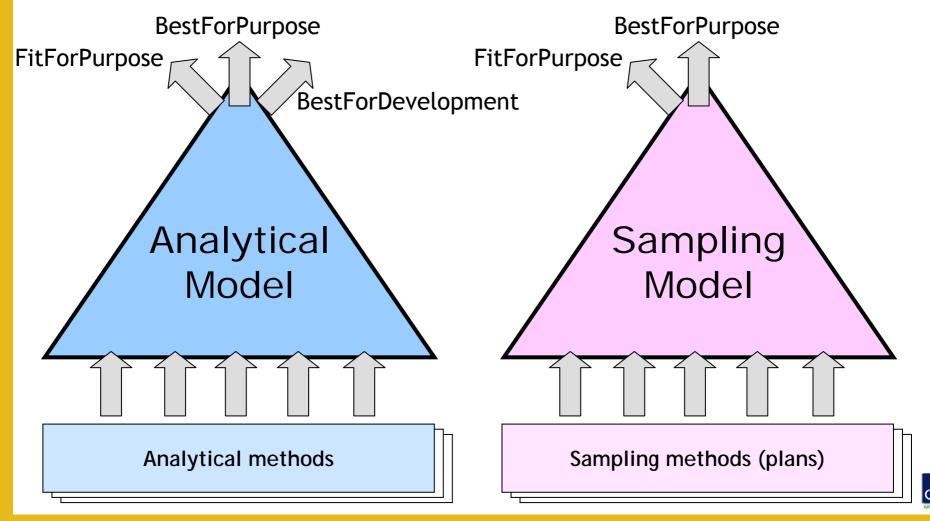






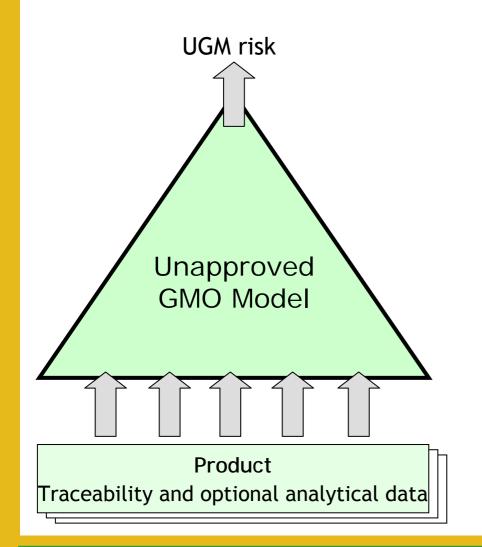


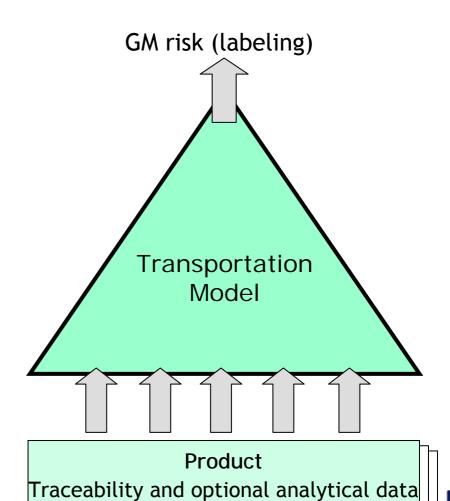
#### Method Assessment Models





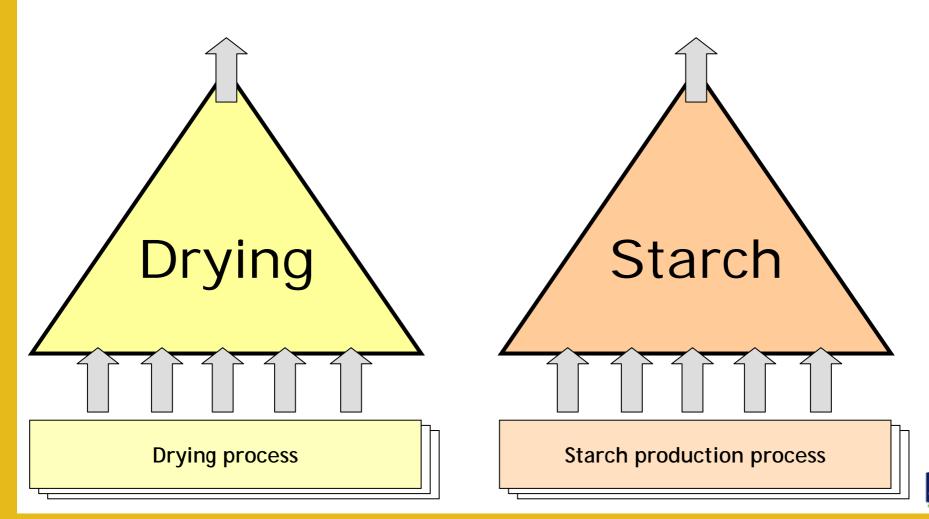
# Risk Assessment from Traceability Data





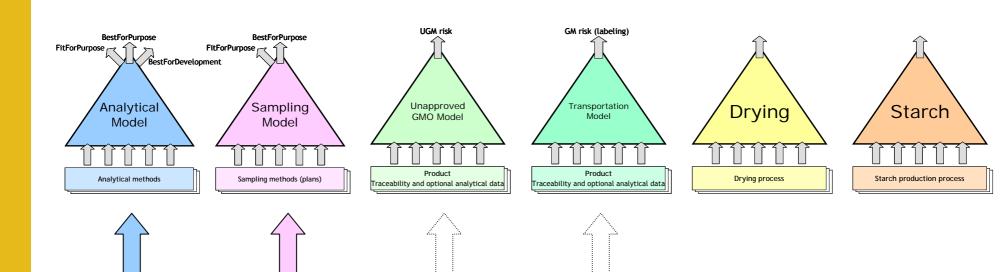


## Supply Chain Process Models [INRA Simulations]





# Co-Extra DSS Structure



Data base: Methods and Products

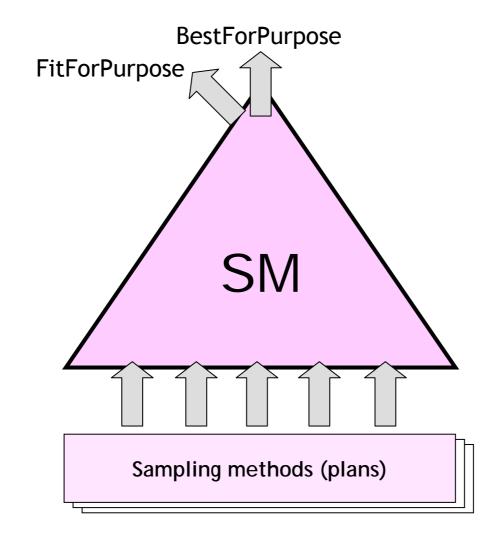








# SM: Assessment of Sampling Methods



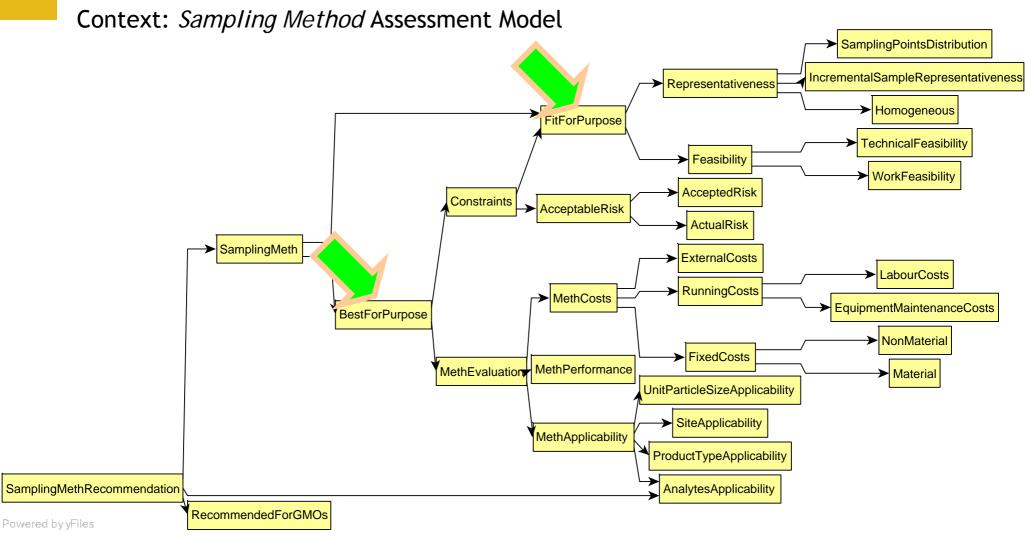






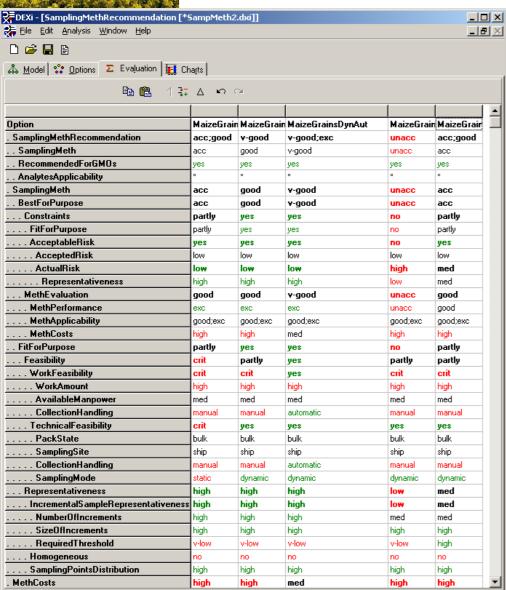


# Sampling Method Model (topmost levels)

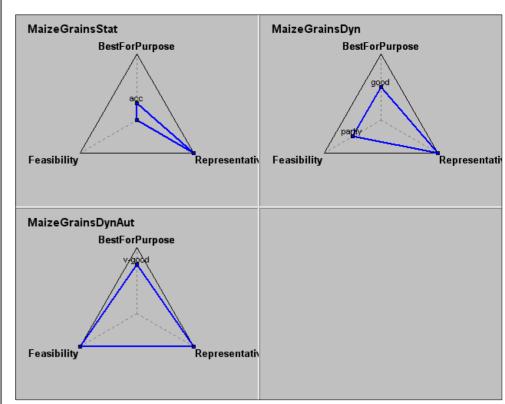




# The Sampling Method Model in DEXi (1/2)



Attributes: 63 (38 basic, 25 aggregate) | Scales: 63 | Functions: 25 | Options: 5









Co-Extra International
Conference
2-5 June 2009 Paris



# The Sampling Method Model in DEXi (2/2)

#### Comparison of options

Attribute	MaizeGrainsStat	MaizeGrainsDyn	MaizeGrainsDynAut
SamplingMeth	acc	good	v-good
–BestForPurpose	acc	good	v-good
-Constraints	partly	yes	<i>yes</i>
<i>⊢FitForPurpose</i>	partly	yes	yes
└-AcceptableRisk	yes		
⊢AcceptedRisk	low		
└-ActualRisk	low		
└-Representativeness	high		
└MethEvaluation	good		v-good
−MethPerformance	exc		
–MethApplicability	good; <i>exc</i>		
└ <i>Meth</i> Costs	high		med

#### Plus-Minus-1 analysis

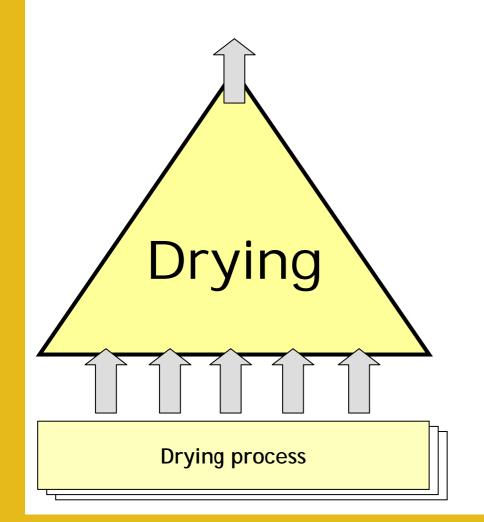
Attribute	)	-1	MaizeGrainsStat	+1
SamplingMeth			acc	
	–AcceptedRisk	[	low	
·	–AcceptedRisk –A∨ailableManpower	_	med	
'	<sup>∟</sup> SamplingMode	[	static	good
·	-NumberOfIncrements	unacc	high	]
	SizeOfIncrements	unacc	high	]
-	Hom ogeneous	[	no	
L	SamplingPointsDistribution	unacc	high	]

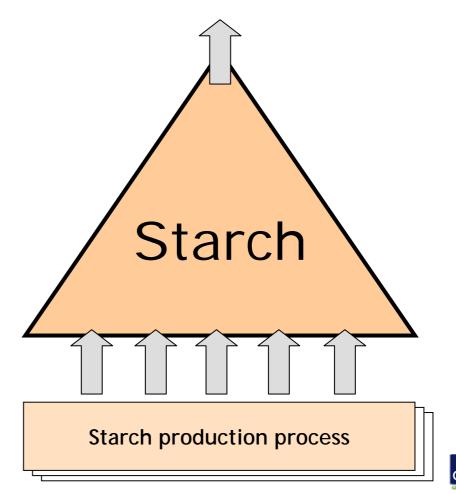






# Supply Chain Process Models

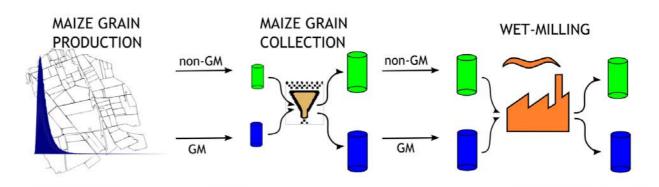






#### Basis: Maize simulation model [INRA]

PHYSICAL FLOWS



SCHEDULING OF THE BATCHES

Drying scheduling

Processing scheduling

CONTROL OF THE BATCHES

- Simple traceability (identifying batches from either GM or non-GM varieties)
- Simple traceability + automatic downgrading of non-GM batches (clean flushing with product)
- Simple traceability + PCR testing of non-GM batches at various level of the supply chain in order to identify the non-GM batches not complying with the threshold









# Basis: Simulation Results [INRA]

Arial     10														
K2 ▼														
_	Α	D	Е	F	G	Н	ı	K	L	М	N	0	Р	Q
	REP	AMONT			PGM 🔽	ksech 🔽	SCENARIO	MEAN	SD ▼	NPCR 🔻	n11 🔻	n12 ▼	n21 🔻	n22 ▼
	1	distri cas1	0,00180977		0,1	1	no downgrading	0,02094016		0	312	0	588	100
	2	distri cas1	0,00180977		0,5	1	no downgrading	0,09761596		0	0	0	500	500
	3	distri cas2	0,00184262		0,1	1	no downgrading	0,02082811	0,0178215	0	313	0	587	100
	4	distri cas2	0,00184262		0,5	1	no downgrading	0,09566667		0	0	0	500	500
	5	distri cas3		0,00321556	0,1	1		0,02390164		0	304	0	596	100
L	6	distri cas3	_	0,00321556	0,5	1	no downgrading	0,09981857		0	1	0	499	500
	7	distri cas4		0,00752106	0,1	1	no downgrading	0,02365365		0	320	0	580	100
	8	distri cas4	_	0,00752106	0,5	1	no downgrading	0,09946913		0	1	0	499	500
L	9	distri cas5	0,00827668		0,1	1		0,02682534	0,0176062	0	230	0	670	100
L	10	distri cas5	0,00827668		0,5	1	no downgrading	0,1037483	0,0309958	0	0	0	500	500
L	11	distri cas6	0,00823522		0,1	1	no downgrading		0,01748743	0	189	0	711	100
L	12	distri cas6		0,01564738	0,5	1	no downgrading	0,10128683		0	1	0	499	500
L	13	distri cas1	0,00180977		0,1	10	, ,	0,00382274		0	804	0	96	100
L	14	distri cas1	0,00180977		0,5	10	no downgrading	0,01166161		0	240	0	260	500
L	15	distri cas2	0,00184262		0,1	10	no downgrading	0,00377205		0	809	0	91	100
L	16	distri cas2	0,00184262		0,5	10	no downgrading	0,01094344		0	261	0	239	500
	17	distri cas3	0,00499922		0,1	10		0,00684554		0	813	0	87	100
L	18	distri cas3			0,5	10	no downgrading	0,01443734		0	251	0	249	500
L	19	distri cas4		0,00752106	0,1	10	no downgrading	0,00657323		0	818	0	82	100
L	20	distri cas4		0,00752106	0,5	10	no downgrading	0,01429404		0	250	0	250	500
	21	distri cas5	0,00827668		0,1	10		0,01017191		0	570	0	330	100
L	22	distri cas5	0,00827668		0,5	10	no downgrading	0,01807216		0	100	0	400	500
	23	distri cas6	0,00823522		0,1	10	no downgrading	0,01007396		0	523	0	377	100
	24	distri cas6			0,5	10	no downgrading	0,01781689		0	105	0	395	500
	25	distri cas1	0,00180977		0,1	100	no downgrading	0,00199457		0	891	0	9	100
	26	distri cas1	_		0,5	100	no downgrading	0,0026094	0,00342264	0	479	0	21	500
L	27	distri cas2	0,00184262		0,1	100	no downgrading	0,00204521	0,00185166	0	890	0	10	100
	28	distri cas2	0,00184262		0,5	100	no downgrading	0,00286656	0,00388227	0	472	0	28	500
L	⊃a   ► N\table /	, dictri coc3	വ വാദ്യാവ	0.00321666	0.1	100	no downarodina	0.00501051	าบบบโลวเลย [	n	ഉമറ	n l	10 l	100

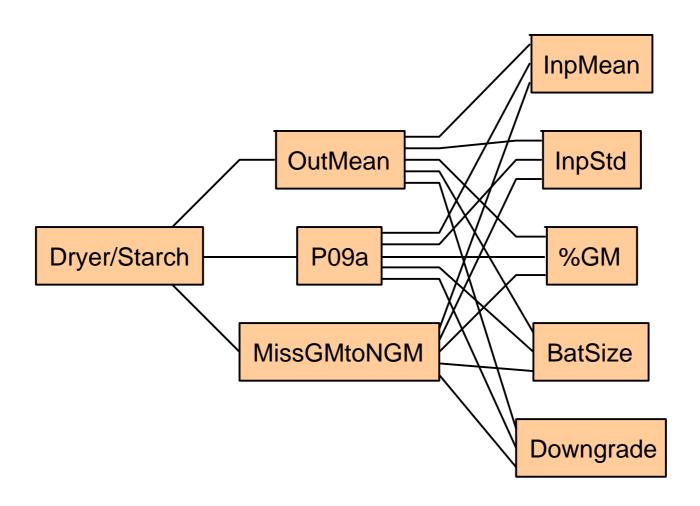








#### Drying and Starch Model: Structure











# Drying Model: Rules

	InpMean	InpStd	%GM	<b>BatSize</b>	Downgrade	OutMean
	67%	0%	6%	19%	8%	
1	high	*	*	*	*	high
2	high;med	*	*	10	none	high
_3	*	*	50	10	none	high
4	med	*	*	100	*	med
5	med	*	*	*	auto;PCRa;PCRb	med
6	med; <i>low</i>	*	50	10	PCRb	med
7	low	*	10	10	none	med
8	low	*	*	100	*	low
9	low	*	*	*	auto;PCRa	low
10	low	*	10	*	auto;PCRa;PCRb	low

	InpMean	InpStd	%GM	BatSize	Downgrade	P09a
	23%	5%	26%	30%	16%	
1	high	*	50	10	none	0.75
2	high	*	50	10	auto	0.5
3	med	high	50	10	none	0.5
4	low	low	50	10	none	0.5
5	high	high	*	100	none;auto	0.25
6	high	*	50	100	none	0.25
7	high	*	50	10	PCRa;PCRb	0.25
8	high	high	10	*	none;auto	0.25
9	high	*	10	10	none;auto	0.25
10	med	low	<b>50</b>	10	none	0.25
11	low	high	50	10	none	0.25
12	*	*	*	100	PCRa;PCRb	0
13	*	*	10	*	PCRa;PCRb	0
14	*	low	*	100	auto;PCRa;PCRb	0
15	*	low	10	100	*	0
16	med; <i>low</i>	*	*	100	*	0
17	med; <i>low</i>	*	*	*	auto;PCRa;PCRb	0
18	med; <i>low</i>	*	10	*	*	0

	InpMean	InpStd	%GM	<b>BatSize</b>	Downgrade	MissGMtoNGM
	45%	1%	10%	7%	37%	
1	high	*	*	*	none;auto	high
2	*	*	*	*	none	high
_3	high	low	10	100	PCRb	high
4	high	high	*	*	PCRa;PCRb	med
5	high	*	50	*	PCRa;PCRb	med
6	high	*	*	*	PCRa	med
7	high	*	*	10	PCRa;PCRb	med
8	med	*	50	*	auto	med
9	low	*	10	100	PCRb	med
10	med	*	50	*	PCRb	low
11	med; <i>low</i>	high	50	*	PCRb	low
12	med; <i>low</i>	high	50	10	PCRa;PCRb	low
13	med; <i>low</i>	*	*	10	PCRb	low
14	med	high	10	10	auto	low
15	low	*	*	10	PCRa;PCRb	low
16	low	low	50	*	PCRa	low
17	med	*	*	100	PCRa	none
18	med; <i>low</i>	high	*	100	PCRa	none
19	med	*	10	100	auto;PCRa;PCRb	none
20	med; <i>low</i>	*	10	100	auto;PCRa	none
21	med	*	10	*	PCRa	none
22	med	low	*	*	PCRa	none
23	med	low	10	*	auto;PCRa	none
24	med; <i>low</i>	low	10	*	auto	none
25	low	high	*	100	auto;PCRa	none
26	low	*	*	*	auto	none
27	low	low	50	100	PCRb	none









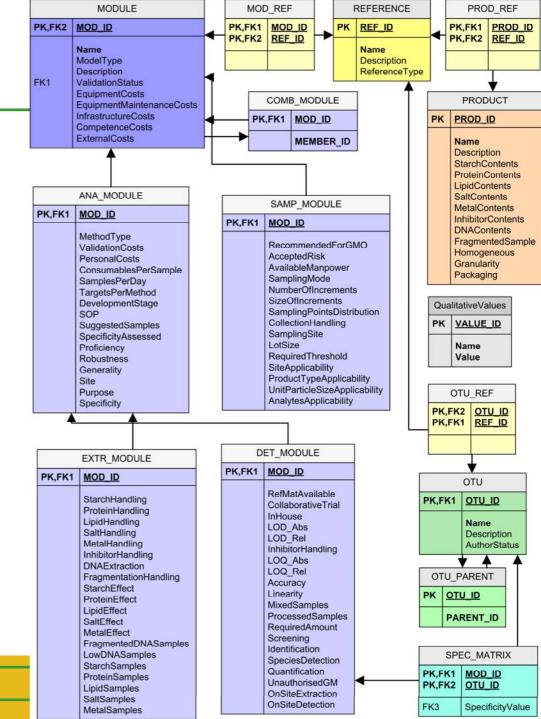
#### The Database

#### Purpose:

- Storing data on:
  - products ('biological matrix', documentary traceability data)
  - methods (e.g. extraction and detection methods, sampling methods)
  - OTUs: Operational Taxonomic Units (such as GMOs and taxa)
  - references
- Providing:
  - information for Data-based DSS (queries, reports, data analysis)
  - + input data for the DSS models

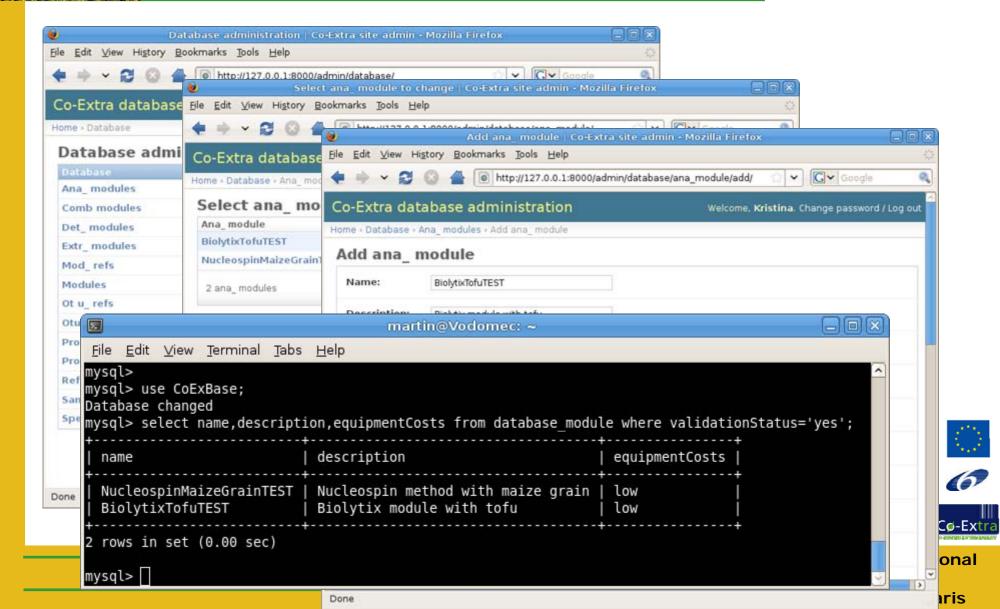
#### **Current status:**

Design, prototype implementation





#### **Database Screenshots**





#### Co-Extra DSS Summary

#### Purpose:

- Addressing decision problems relevant for various stakeholders
- ► Transferring project results into models, which:

  - capture and represent expert knowledge (decision rules)
    assess/evaluate "decision alternatives" [analytical methods, sampling plans, products, process control scenarios]
  - provide decision-analysis tools ["what/if" analysis, sensitivity analysis, selective explanation, ...]
- Providing a database on "decision alternatives"

#### Current status:

- Completed models and database structure
- ► Six models: AM, SM, UGM, TM, Drying, Starch
- Database: prototype implementation

#### To do:

- Validation of models on selected cases
- Prototype implementation of the DSS and "proof of concept"
- Dissemination









## Thank you ...



Jožef Stefan Institute, Ljubljana, Slovenia





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RIKILT



#### Veterinærinstituttet

National Veterinary Institute



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