GERMAN FEDERAL INSTITUTE FOR RISK ASSESSMENT

RAKIP

risk assessment modelling & knowledge integration platform

anses French agency for food, environmental and occupational health safety

BfR Bundesinstitut für Risikobewertung

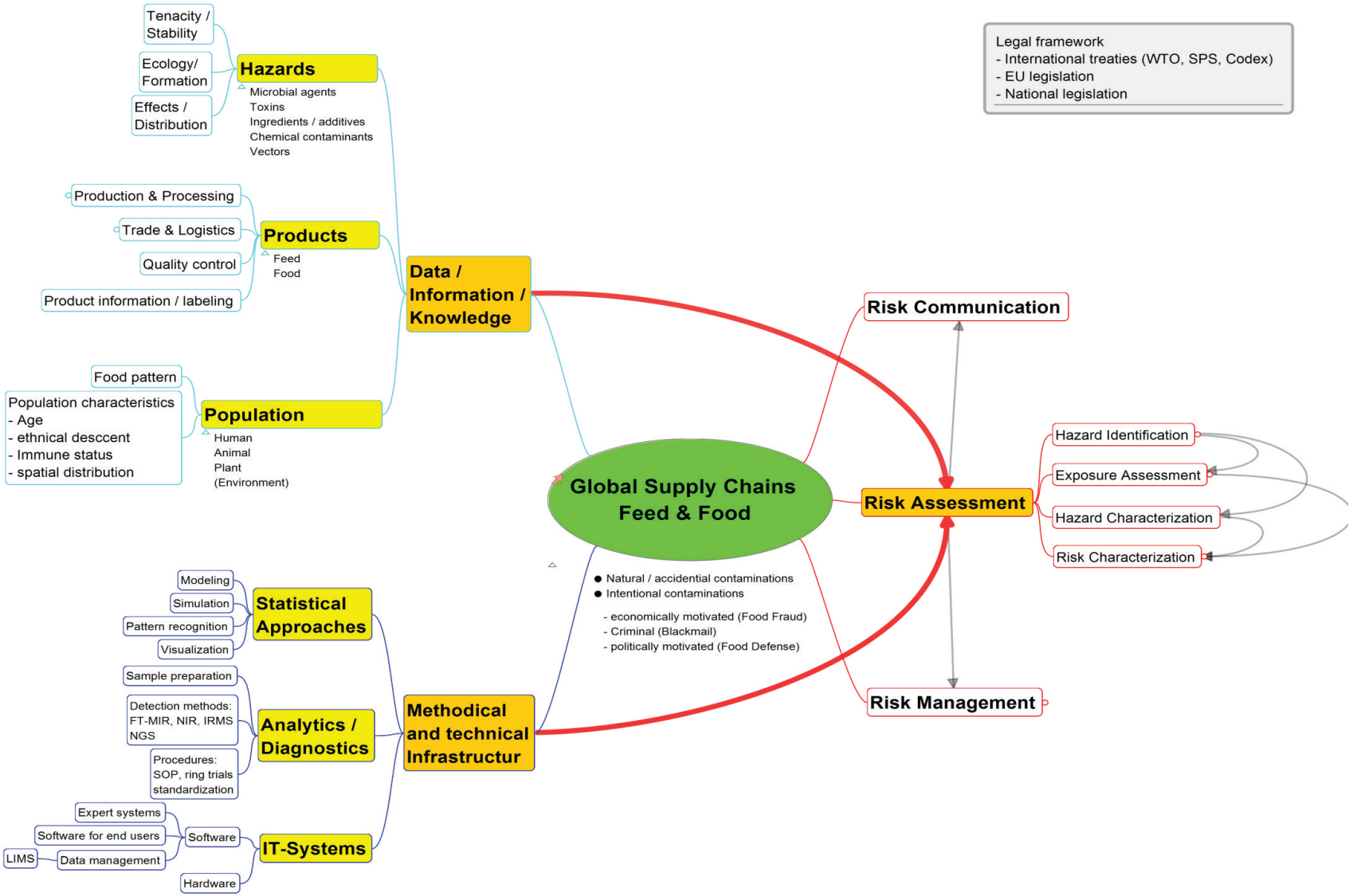
DTU Food National Food Institute

DTU

Risk Assessment Modelling and Knowledge Integration Platform (RAKIP)

Matthias Filter

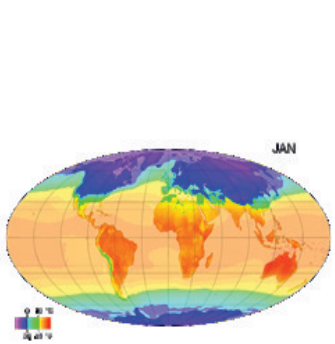
Global Supply Chains and Risk Assessment

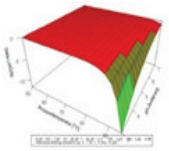


Page 2

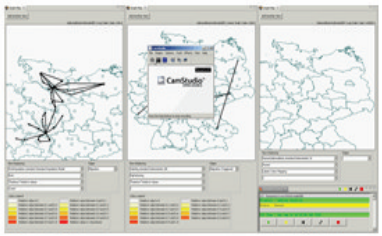
Risk Assessor's Needs

DATA, MODELS and TOOLS !





Predictive Microbial Models



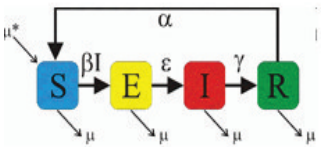
Agricultural Production

Processing

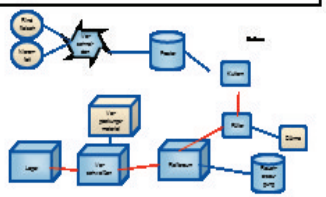
Distribution

Human Consumption

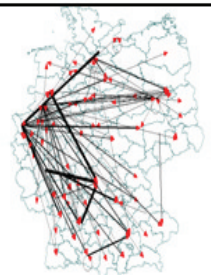
Animal Disease Models



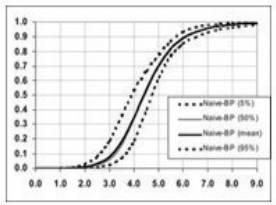
Processing Models



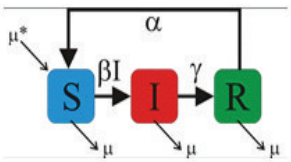
Supply Chain Models



Dose Response Models

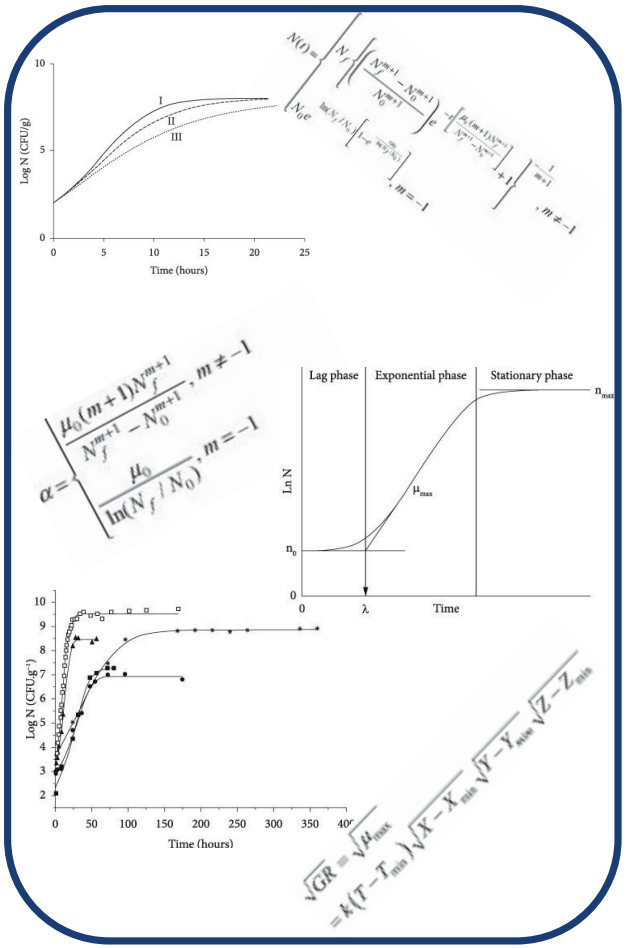


Human Disease Models



Current Situation

1. Plenty of data and models published



2. Several software tools for model based predictions and simulations

BASELINE
PMM-Lab
FDA-iRISK food safety modeling tool
KU LEUVEN
DANISH MEAT RESEARCH INSTITUTE
INRA SCIENCE & IMPACT
PREVIUS
ComBase
microHibro
MRV Microbial Responses Viewer
NIZO YOUR FOOD RESEARCHERS
FSSP
azti tecnalia
ACTALIA
Cniel

3. However…

- **NO common FORMAT to describe models / data**

=> NO information exchange between software tools

- **FEW open-source software solutions**

=> FEW models implemented into ready-to-use tools

=> Re-use of EXISTING knowledge HAMPERED

Issues with Model Re-implementation

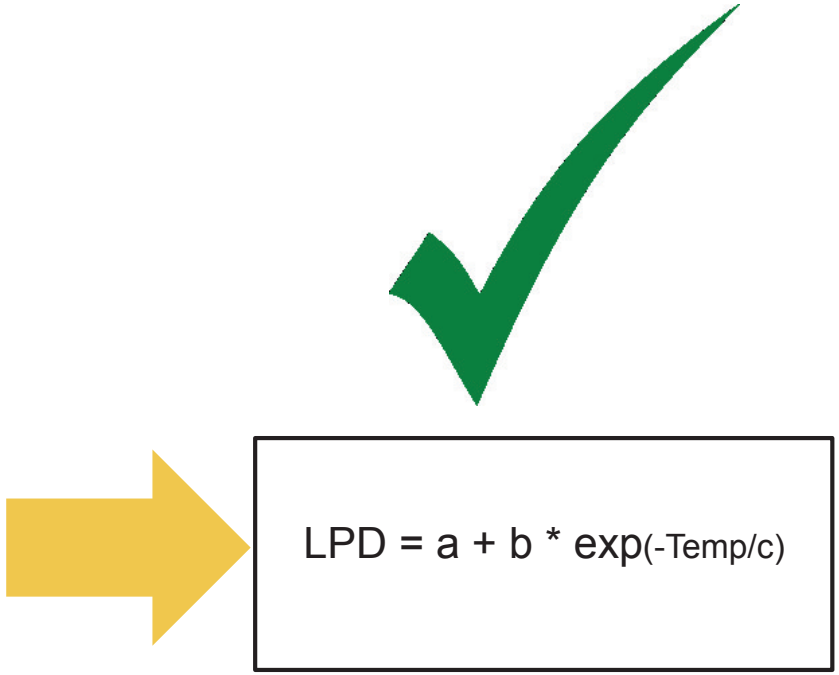
e.g. typos in model equations / formulas

LPD. Researchers have proposed that bacterial LPD is related to the time required for cells to adjust physiologically to a new environment (2, 3). In the case of spore-forming organisms, LPD would also include the time required for spores to germinate and the time required for the resulting vegetative cells to adjust to g[illegible]h in the food [illegible]x. Baranyi et al. (3) developed a dynamic g[illegible]th model [illegible] includes a mechanistic parameter for LPD, and [illegible] mo[illegible]as used to describe LPD. For the majority of bacte[illegible]nogens, the LPD has been shown to decrease with in[illegible] temperature, and a similar trend was observed for *[illegible]th[illegible]* Sterne and Ames K0610. The LPD significantly [illegible]reased fr[illegible]53 h at 18°C to 6.8 h at 44°C (Table 2 and [illegible]. 2). This dis[illegible]ion of LPD can be described with an exponential model (equation 2).

$$LPD = a + b^{(-temp/c)} \quad (2)$$

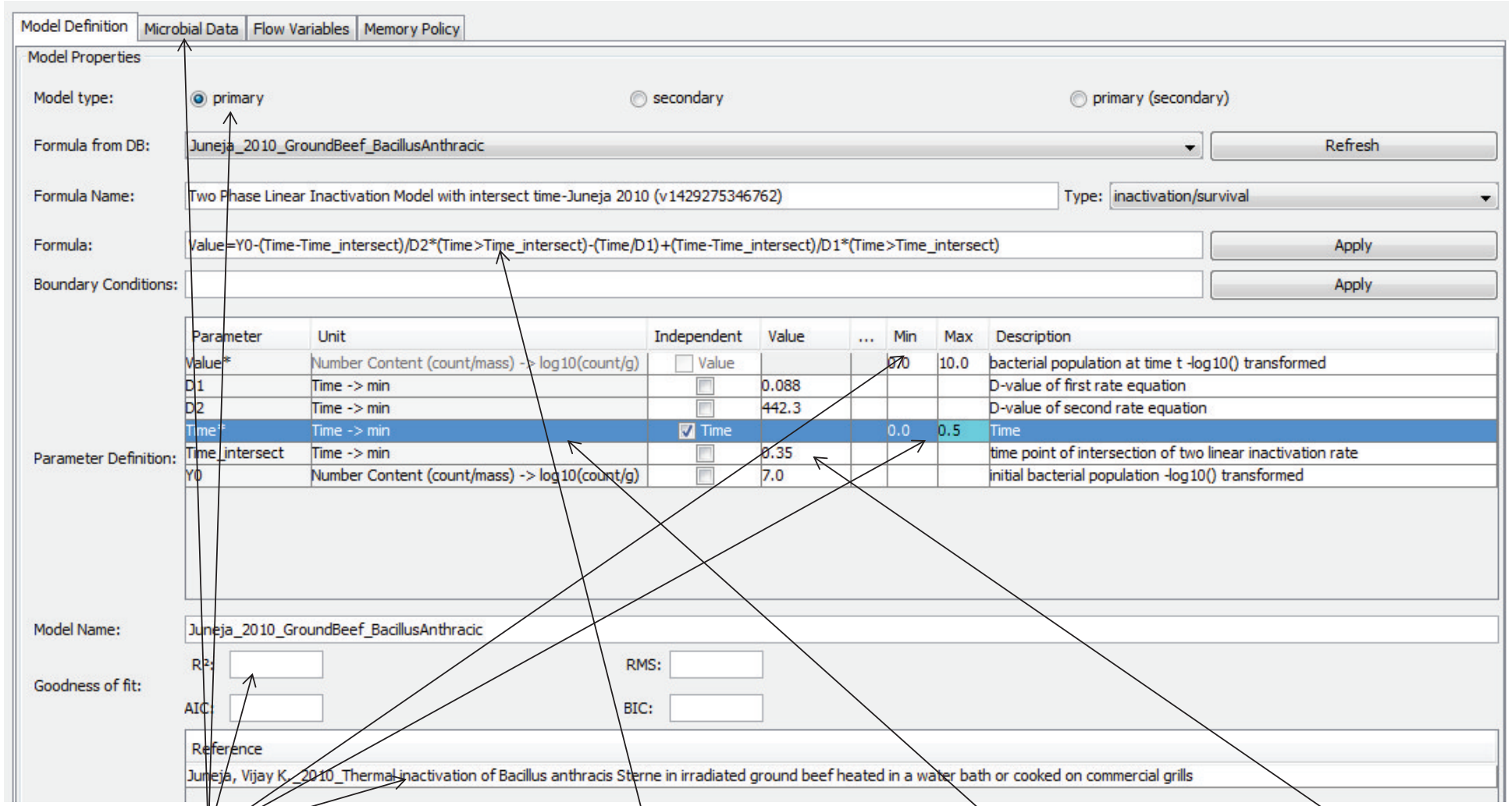
where $a = 2.3573$, $b = 3.47E8$, $c = 11.0396$, and $R^2 = 0.96$.

The observed LPD for Ames K0610 was within or close to the 95% confidence intervals for the Sterne secondary model (Fig. 2).



Issues with Model Re-implementation

e.g. erroneous re-implementation



RAKIP Vision

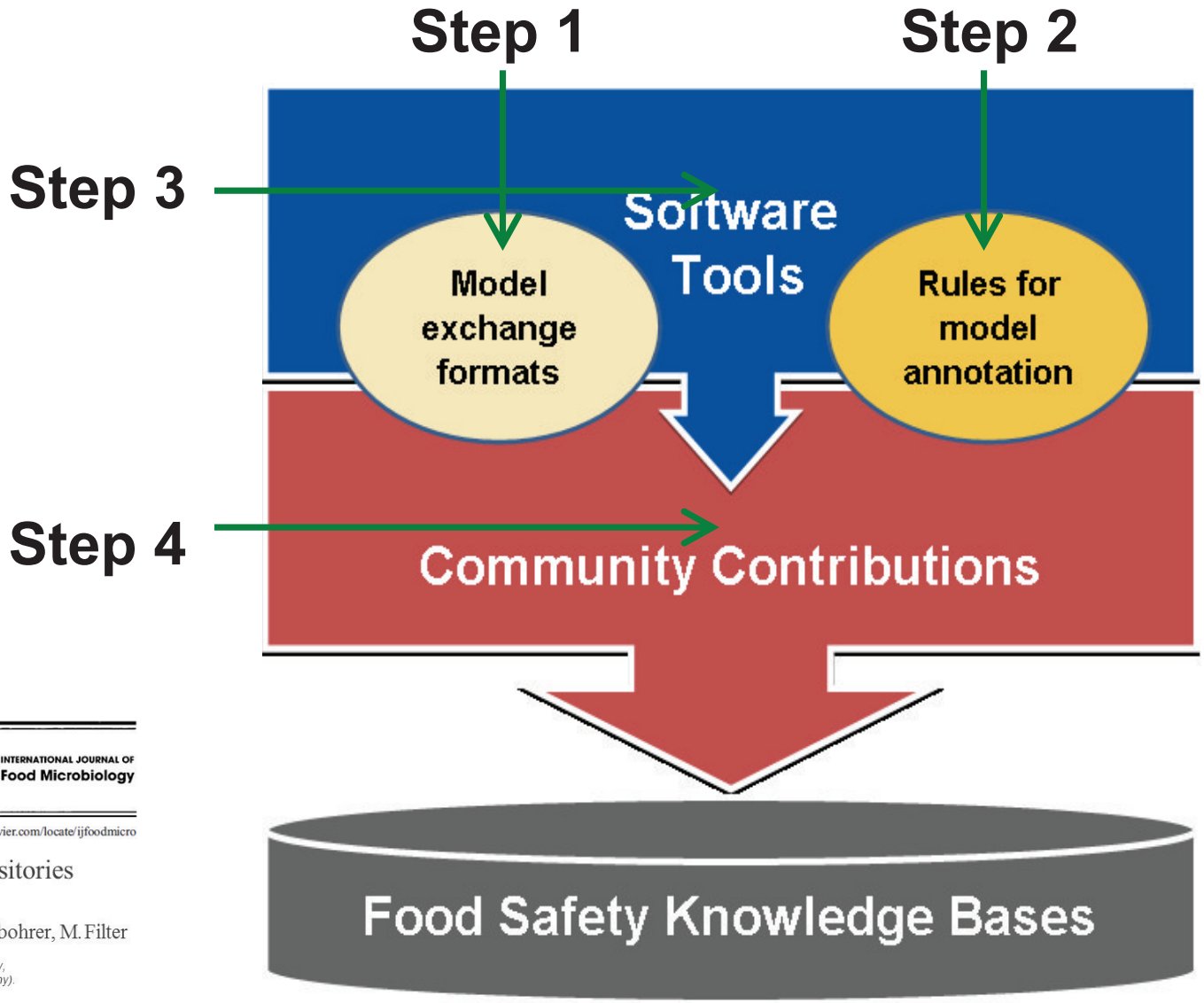
Community-driven, curated repositories of food safety models / model modules (Food Safety Knowledge Bases)

Newly generated models / re-implemented models / legacy models

Repository GUI with search, info and model download

Model deployment

RAKIP Approach



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INTERNATIONAL JOURNAL OF Food Microbiology

www.elsevier.com/locate/ijfoodmicro

A strategy to establish Food Safety Model Repositories

C. Plaza-Rodriguez, C. Thoens, A. Falenski, A. Weiser, B. Appel, A. Kaesbohrer, M. Filter

Federal Institute for Risk Assessment. Department Biological Safety. Unit Epidemiology, Zoonoses and Antimicrobial Resistance. Max-Dohrn-Straße 8-10. 10589 Berlin. (Germany).

http://www.researchgate.net/publication/273791203_A_strategy_to_establish_Food_Safety_Model_Repositories

RAKIP: Project

- Two years ago … a discussion at the ICPMF9 conference
- One year ago … a proposal for a tri-lateral funded collaboration project between ANSES, DTU, BfR
- January 2017: start of RAKIP !

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DTU Food National Food Institute DTU

Director General ANSES
Mrs. Caroline Gardette
President BfR
Prof. Dr. Dr. Andreas Hensel
Director National Food Institute DTU
Dr. Christine Nelleman

04/22/2016

Project Proposal "Joint Modelling and Knowledge Integration Platform"

Dear Directors,
Dear President,

we, the signing ANSES, BfR and DTU research scientists, approach you today with a request to initiate an internally funded tri-lateral scientific capacity building project addressing key objectives of the ANSES-BfR-DTU collaboration agreement.
The collaboratively developed project proposal specifically aims at sharing scientific and technical expertise in the area of food safety risk assessment and the piloting of a shared, curated risk model knowledge base. Such infrastructure will facilitate the efficient exchange of data and model-based resources between the three institutes and promote future joint risk assessments on various public health issues. In addition, this project generates a pilot system that serves as a critical reference for several, planned EU grant applications aiming at the harmonization and adoption of model-based risk assessment solutions.
The project outline and expected results are detailed in the attached project summary.

In advance, the signees want to thank for a favourable examination and timely decision.

Yours sincerely

Laurent Guillier Ph.D.	Matthias Filter, Dipl.-Biochem.	Maarten Nauta, Ph.D.	Paw Dalgaard Professor, Ph.D.
Agence national de sécurité sanitaire (ANSES) Laboratoire de sécurité des aliments	Federal Institute for Risk Assessment (BfR) Unit Food Technologies, Supply Chains and Food Defense	National Food Institute (DTU Food) Research Group for Risk-Benefit	National Food Institute (DTU Food) Division of Microbiology and Production
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RAKIP: Results

AGREEMENT

Conceptual framework

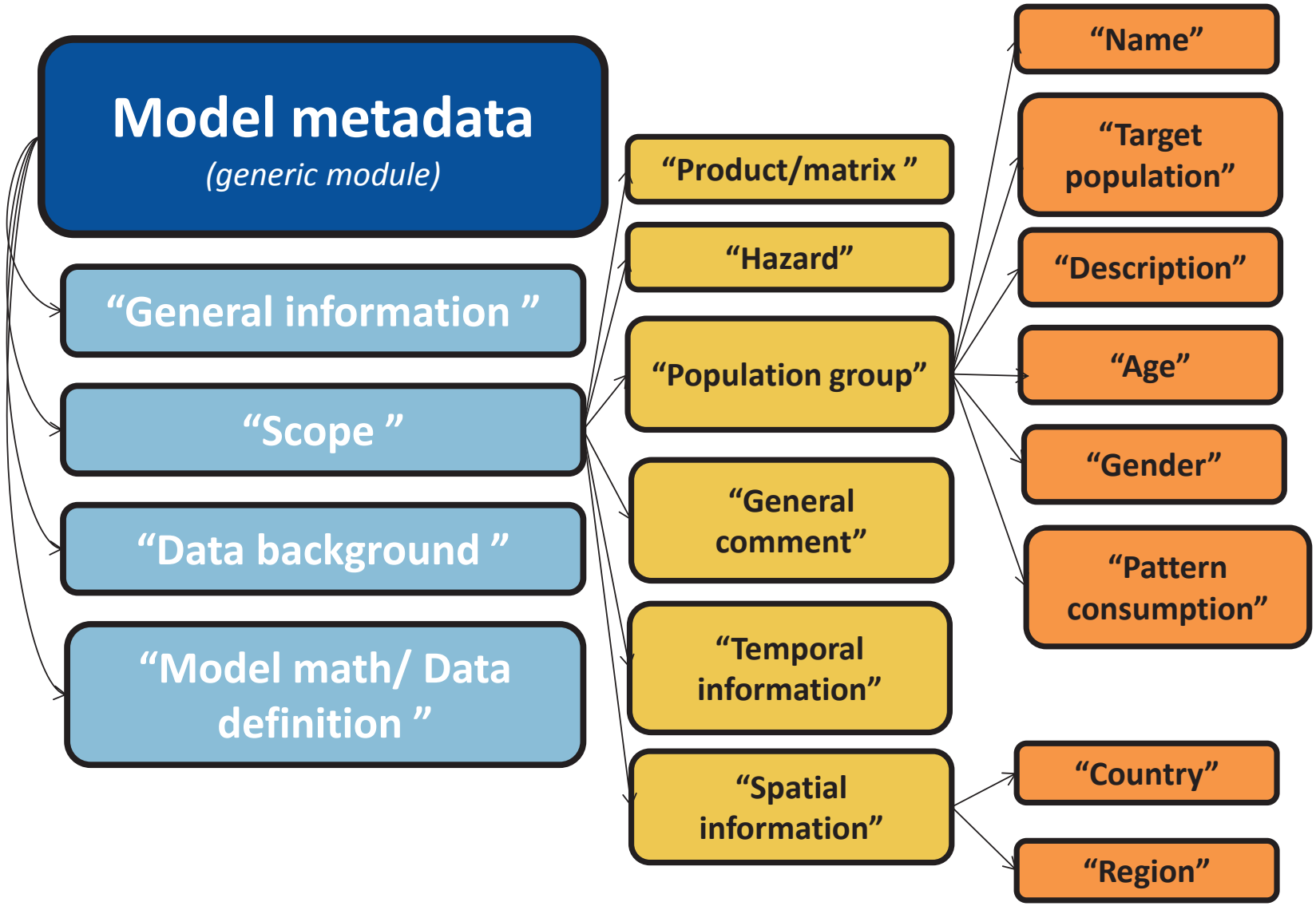
- ✓ Terms and concepts
- ✓ Schemata detailing processes
- ✓ Harmonized vocabulary
- ✓ Glossary
- ✓ Metadata description
- ✓ Controlled vocabularies

RAKIP Results

Glossary

- *Collaborative platform:* Infrastructure set up by ANSES for the RAKIP project that allows the exchange of files, information and, supports communication.
- *Consumption model:* A consumption model consists of a set of one or more population groups, with each group having an associated consumption pattern and an exposure type.
- *Curation:* A curation process for models aims to classify models according to certain quality criteria. These quality criteria must be defined. Depending on the classification, the End-users of the model can e.g. judge how reliable the model might be.
- *Data-driven Knowledge:* Knowledge derived from data obtained from different sources including published and unpublished studies, national or international official data, risk assessments, expert opinions, surveys and questionnaires.
- *Dose-response model:* Model describing the relationship between the magnitude of exposure (dose) to a hazard and the severity and/or frequency of associated adverse effects (response).
- *End-users:* Person who ultimately applies or is intended to ultimately apply a model. In this aspect several levels of End-users can be defined:
  - *Non-expert user:* Person who intendeds to use the model mainly for making predictions without too much interest in the Modelling process.
  - *Expert user:* Person who is interested not only in the model predictions, but also in the Modelling process, including data, Model Equation, Fitting process, etc.
- *Evaluation data:* Experimental/Observational data that have not been used for generation of the to-be-evaluated Fitted model. Its purpose is to evaluate the performance of the Fitted model.
- *Experimental/Observational data:* Measurement values obtained in experiments or generated in observations. Can be used in the Fitting or Validation procedure.

RAKIP Metadata collection as basis for the FSK-ML



RAKIP Metadata collection as basis for the FSK-ML

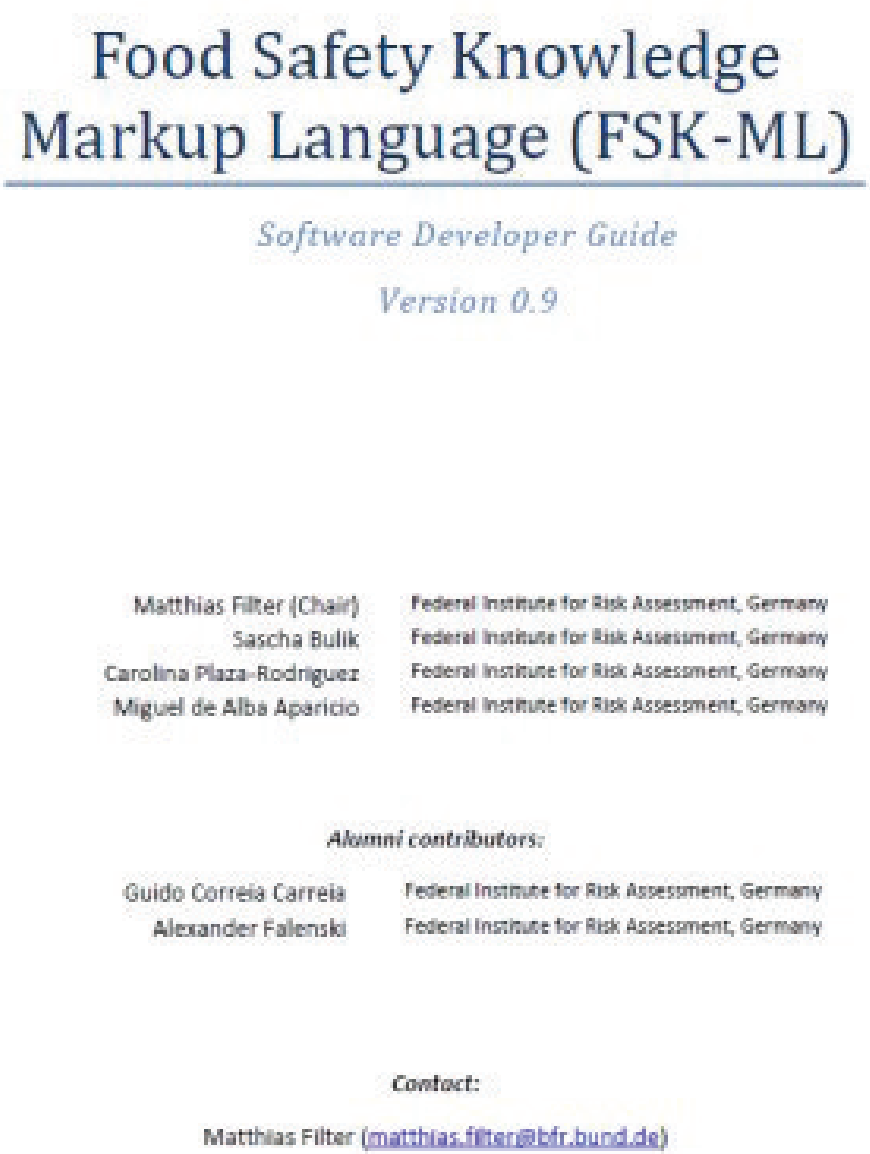
General Information	1	Study / Data / Model Name	1		
		Source	0:1		
		Identifier	1		
		Creator(s)	1:N	vCard 4.0 standard	1
		Date	1:N	Creation date	1
				Last modified date	0:N
		Rights	1	Rights	1
		Availability	1		
		URL	0:1		
		Format	0:1		
		References	1:N	Is_reference_description?	1
				Publication type	0:1
				Publication date	0:1
				PubMed ID	0:1
				Publication DOI	1
				Publication Author List	0:1
				Publication Title	1
				Publication Abstract	0:1
				Publication Journal / Vol / Issue, etc.	0:1
				Publication Status	0:1
				Publication website	0:1
				Comment	0:1
		Language	0:1		
		Software	0:1		
		Programing language	0:1		
		Model category	0:1	Model Class	1
				Model Sub-Class	0:N
				Model Class comment	0:1
				Basic process	0:N
		Status	0:1		
		Objective	0:1		
		Description	0:1		
Scope	1	Product / matrix	0:1	Product/matrix name	1
				Product/matrix description	0:1
				Product/matrix unit	1
				Method of production	0:N
				Packaging	0:N
				Product treatment	0:N
				Country of origin	0:1
				Area of origin	0:1
				Fisheries area	0:1
				Date of production	0:1
				date of expiry	0:1
		Hazard	0:1	Hazard type	1
				Hazard name	1
				Hazard description	0:1
				Hazard unit	1
				Adverse effect	0:1
				Source of contamination	0:1
				Benchmark Dose (BMD)	0:1
				Maximum Residue Limit (MRL)	0:1
				No Observed Adverse Effect Level (NOAEL)	0:1
				Lowest Observed Adverse Effect Level (LOAEL)	0:1
				Acceptable Operator Exposure Level (AOEL)	0:1
				Acute Reference Dose (ARfD)	0:1
				Acceptable Daily Intake (ADI)	0:1
				Hazard ind/sum	0:1
		Population Group	0:1	Population name	1
				Target population	0:1
				Population Span (years)	0:N
				Population description	0:N
				Population age	0:N
				Population gender	0:1
				BMI	0:N
				Special diet groups	0:N
				Pattern consumption	0:N
				Region	0:N
				Country	0:N
				Risk and population factors	0:N
				Season	0:N
		General comment	0:1		
		Temporal information	0:1	Time	1:N
		Spatial information	0:1	Region	0:N
				Country	0:N

Data background	0:1	Study	1	Study Identifier	1
				Study Title	1
				Study Description	0:1
				Study Design Type	0:1
				Study Assay Measurement Type	0:1
				Study Assay Technology Type	0:1
				Study Assay Technology Platform	0:1
				Accreditation procedure for the assay technology	0:1
				Study Protocol Name	0:1
				Study Protocol Type	0:1
				Study Protocol Description	0:1
				Study Protocol URI	0:1
				Study Protocol Version	0:1
				Study Protocol Parameters Name	0:1
				Study Protocol Components Name	0:1
				Study Protocol Components Type	0:1
		Study Sample	0:1	Sample Name (ID)	1
				Protocol of sample collection	1
				Sampling strategy	0:1
				Type of sampling program	0:1
				Sampling method	0:1
				Sampling plan	1
				Sampling weight	1
				Sampling size	1
				Lot size unit	0:1
				Sampling point	0:1
		Dietary assessment method	0:1	Methodological tool to collect data	1
				Number of non-consecutive one-day	1
				Dietary software tool	0:1
				Number of food items	1:N
				Type of records	1:N
				Food descriptors	1:N
		Laboratory	0:1	Laboratory accreditation	1:N
				Laboratory Name	0:1
				Laboratory country	0:1
		Assay	0:1	Assay Name	1
				Assay description	0:1
				Percentage of moisture	0:1
				Percentage of fat	0:1
				Limit of detection	0:1
				Limit of quantification	0:1
				Left-censored data	0:1
				Range of contamination	0:1
				Uncertainty value	0:1
Model math / Data definition	1	Parameter / Factor / Input / Output / "Data column"	1:N	Parameter ID	1
				Parameter classification	1
				Parameter name	1
				Parameter description	0:1
				Parameter type	0:1
				Parameter unit	1
				Parameter unit category	1
				Parameter data type	1
				Parameter source	0:1
				Parameter subject	0:1
				Parameter distribution	0:1
				Parameter value	0:1
				Parameter Reference	0:1
				Parameter variability subject	0:1
				Range of applicability of the model	0:N
				Parameter error	0:1
		Quality measures	0:N	SSE / MSE / RMSE / Rsquared / AIC / BIC	0:N
				Sensitivity analysis	0:N
		Model equation	0:N	Model equation name	1
				Model equation class/distribution	0:1
				Model equation reference	0:N
				Model equation / Script	1
				Hypothesis of the model	
		Fitting procedure	0:1		
		Exposure	0:1	methodological treatment of left-censored data	
				Level of contamination after left-censored data treatment	
				type of exposure	
				Scenario	
				Uncertainty estimation	
		Events	0:N		

https://docs.google.com/spreadsheets/d/1JN296AnRzi1XOKSer40Tdah2rCniOh2e-7veJojxrmw/edit#gid=1855550151

“Standard” for Model Knowledge Representation
Food Safety Knowledge Markup Language

RAKIP
risk assessment modelling & knowledge integration platform
anses | BfR Bundesinstitut für Risikobewertung | DTU Food National Food Institute



Food Safety Knowledge Markup Language (FSK-ML)

Software Developer Guide

Version 0.9

Matthias Filter (Chair) — Federal Institute for Risk Assessment, Germany
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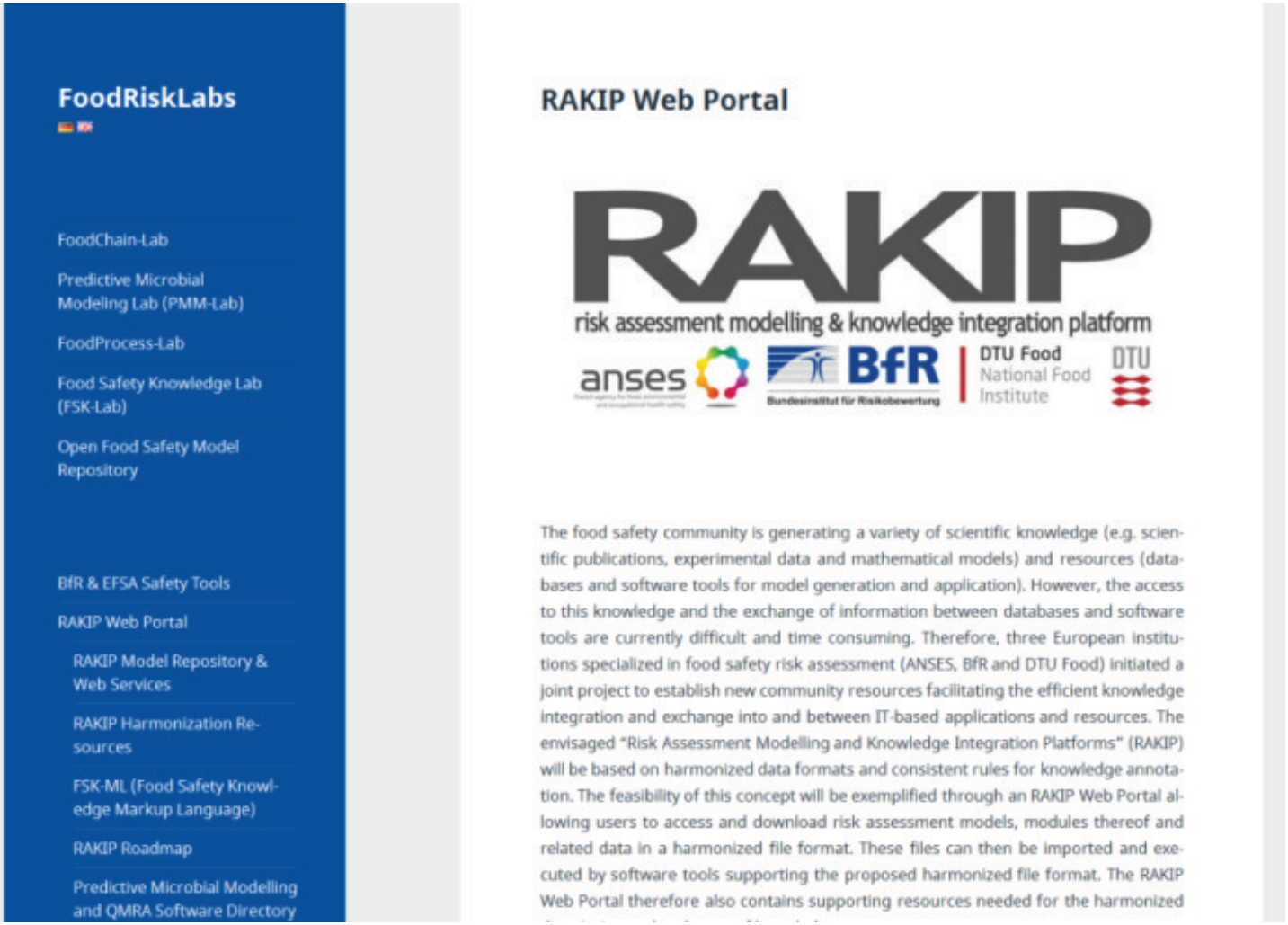
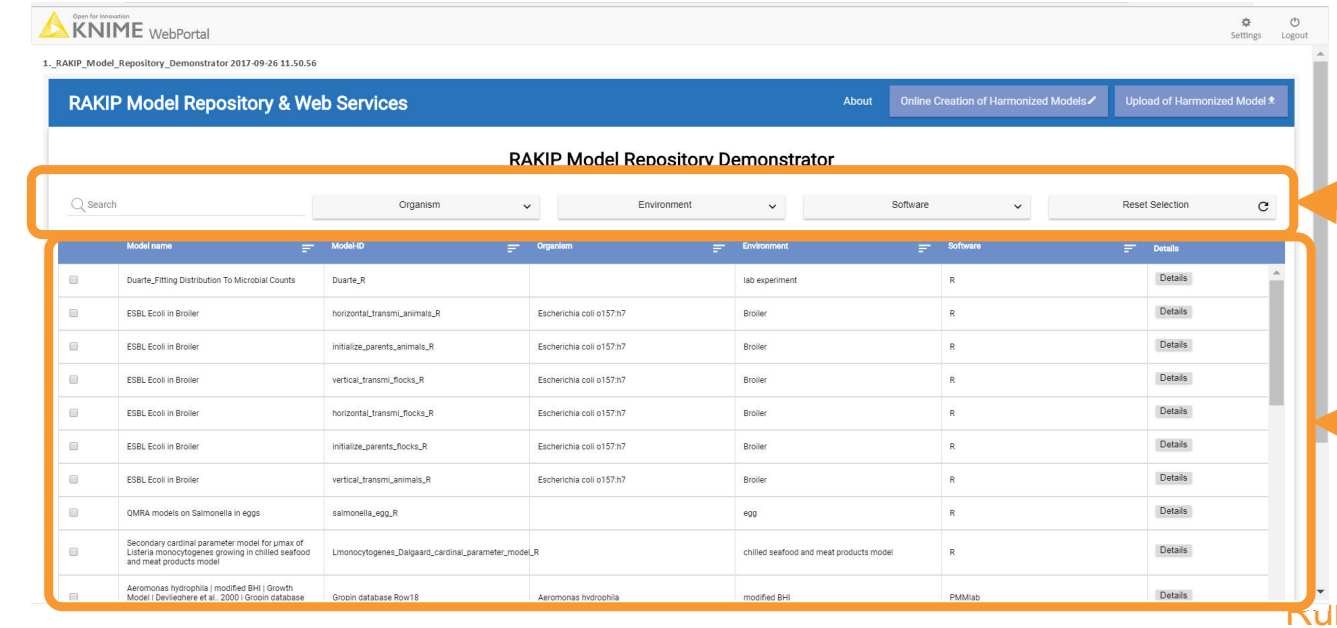
RAKIP Web Portal



RAKIP Model Repository Demonstrator (alpha)

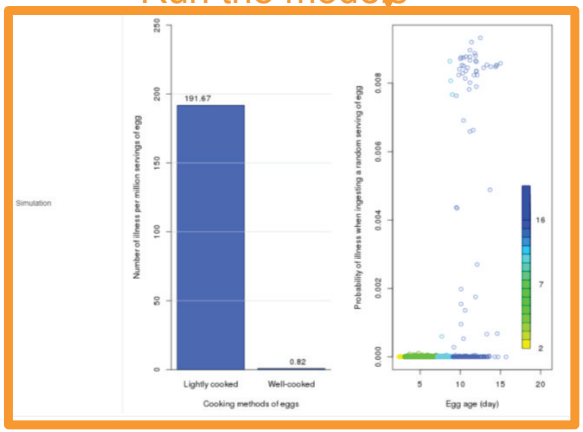


Search for the available models

Select models

Run the models

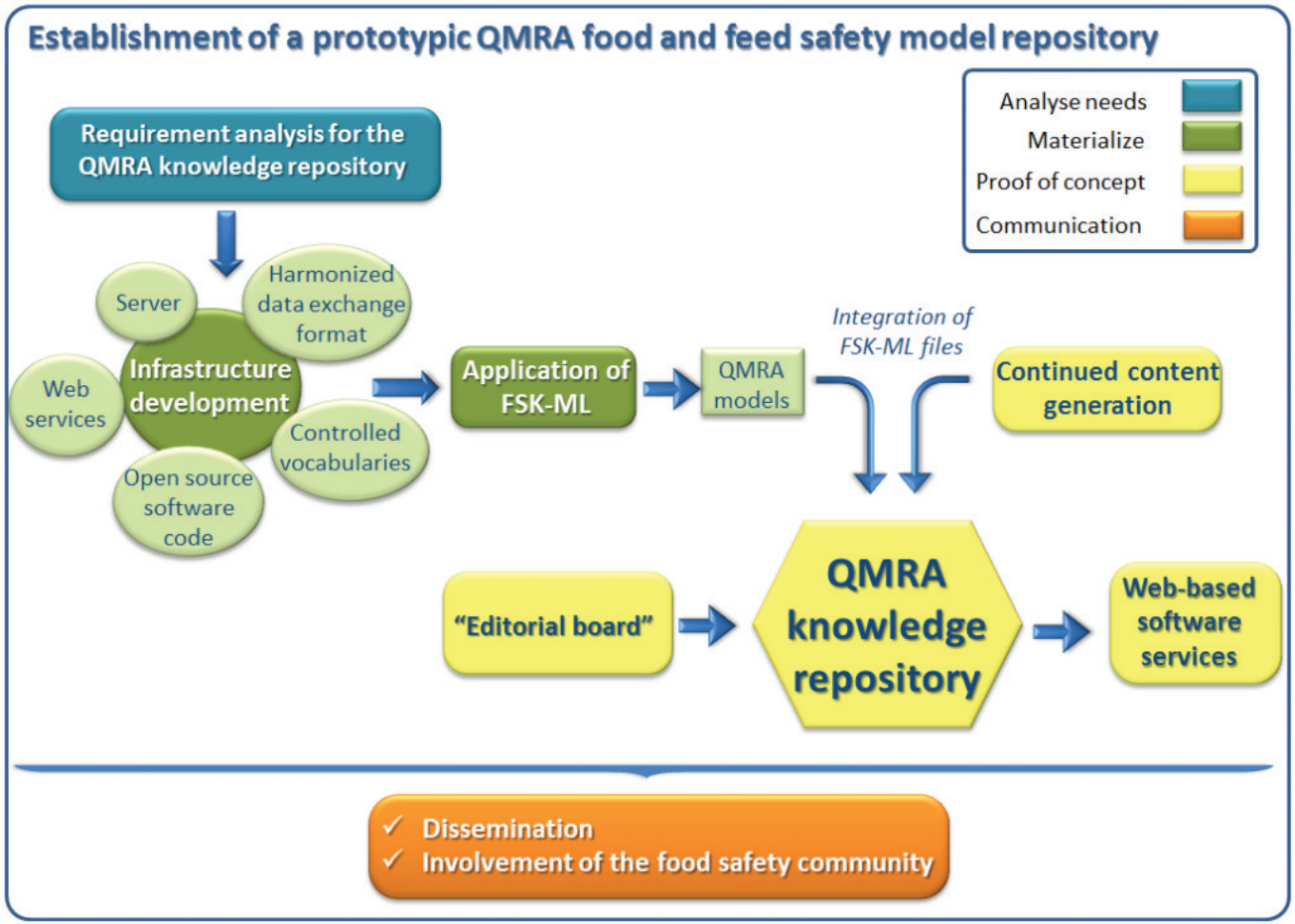
Check the details of a specific model



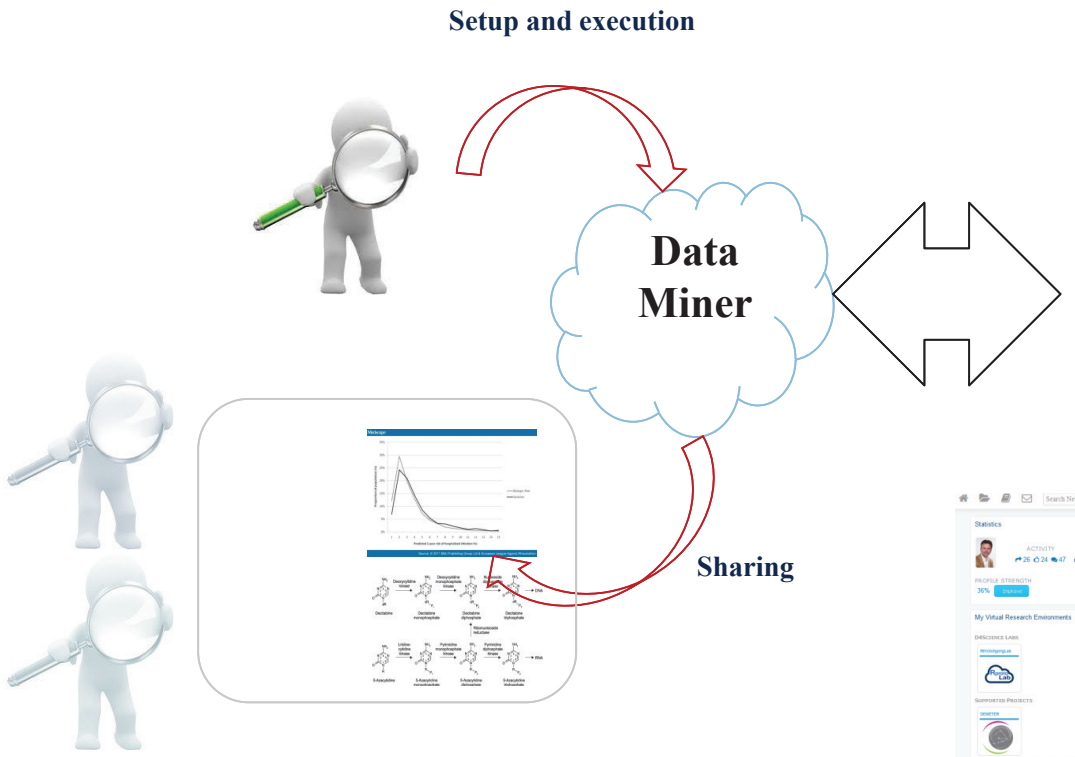
RAKIP – Still a way to go!

- Develop and maintain “operational” web-based infrastructures for knowledge exchange
- Extend and maintain harmonized terms and concepts
- Continuously improve standards / formats for knowledge representation
- Open source software libraries and converter tools to bridge to existing tools / databases / resources
- Promote adoption, create broad support and compliance

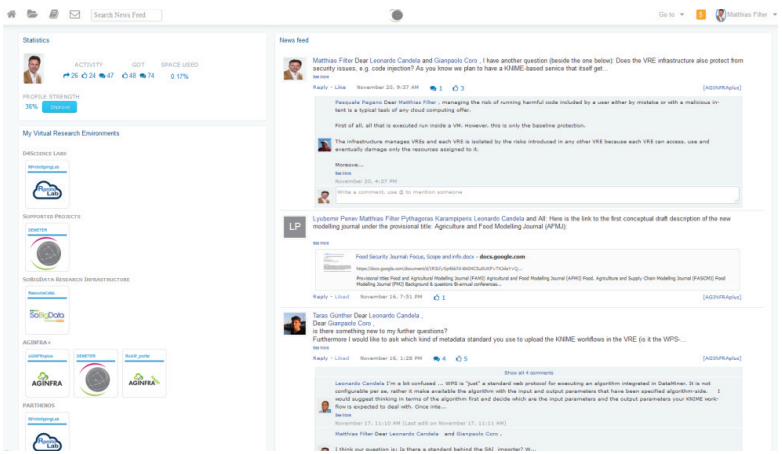
Future Solutions
EFSA- BfR Framework Partnership Agreement



Future Solutions
RAKIP Virtual Research Environment (VRE)



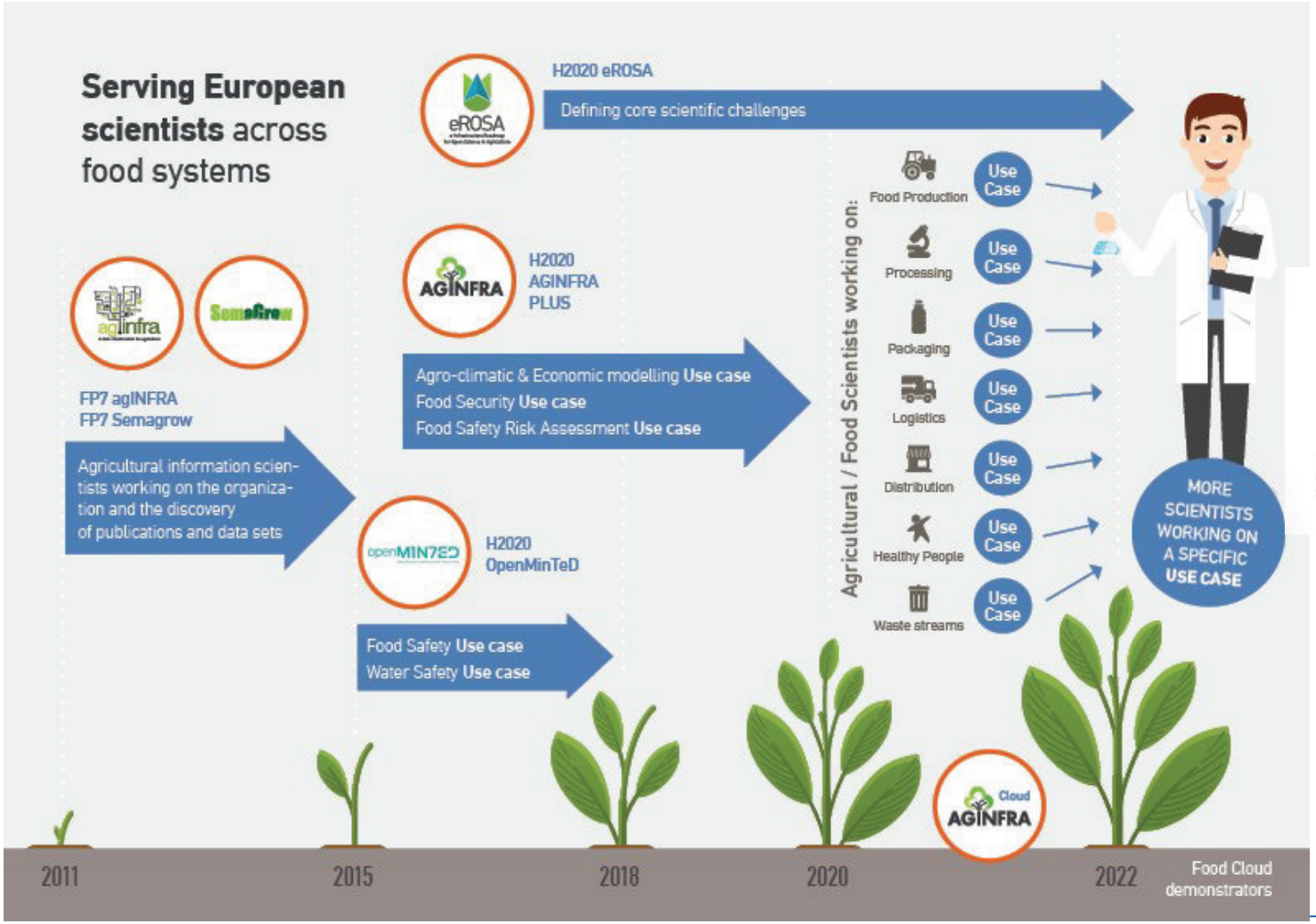
D4Science Computational Facilities



RAKIP Work Plan 2018
Exploration of new areas of application

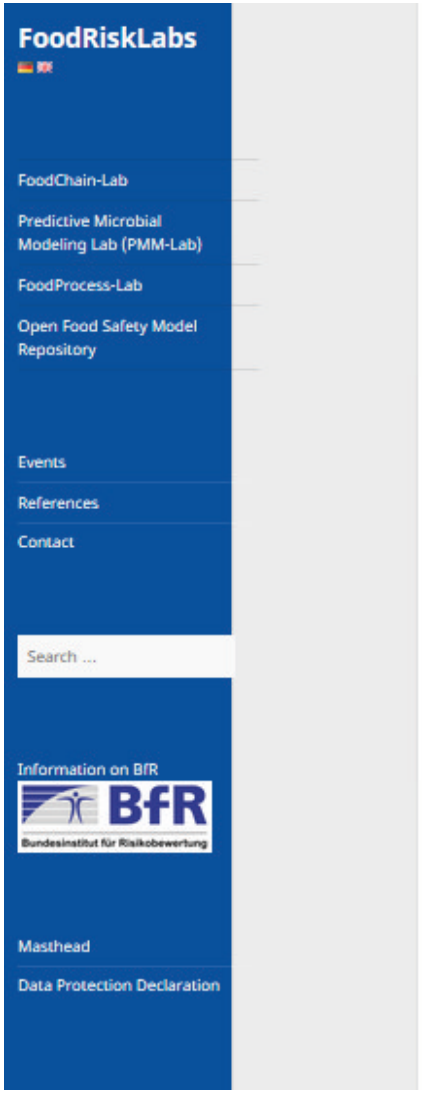
1. Broaden the **knowledge base** in the RAKIP Model Repository
2. Adapt and apply the RAKIP concept in **other areas** like chemical risk assessment (CRA), uncertainty analysis, antimicrobial resistance
3. Extend and improve required **infrastructure** facilitating efficient knowledge exchange (data standards, controlled vocabularies/ meta data schema and open source software code, bridges to popular 3rd party tools)
4. Disseminate and **propagate** the use of RAKIP resources through publications, workshops, software trainings and new collaborations
5. Establish an international **RAKIP Initiative** to promote the long-term maintenance and update of RAKIP resources…

Mid Term Planning
RAKIP as Part of the European Open Science Cloud (EOSC)



Cloud AGINFRA

Finally



https://foodrisklabs.bfr.bund.de

Acknowledgement

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Funding bodies:

ANSES, DTU, BfR

BfR:

IT + HR + Finance + Biological Safety departments, research coordination and international affairs units

Collaboration partners:

EFSA, FDA, Uni Cordoba, AGROKNOW, CNR, KNIME ...

GERMAN FEDERAL INSTITUTE FOR RISK ASSESSMENT

15 YEARS
Science in the Service of Humanity

BfR
Bundesinstitut für Risikobewertung

Thank you for your attention

Matthias Filter

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