Satisfying REACH requirements with OpenTox

Barry Hardy (Douglas Connect, Switzerland)
OpenTox Coordinator

CADASTER Workshop
Maribor, Slovenia
31 August 2011

OpenTox

Introduction

OpenTox has developed an open semantic web for predictive toxicology. (2008-2011: Let's call it OpenTox 1.0)

Today I will:
a)review the OpenTox 1.0 framework within the context of REACH;
b)present some recent developments on OpenTox services and applications and what they can do.

The OpenTox Framework (reported 2010)

Collaborative development of predictive toxicology applications
Journal of Cheminformatics 2010, 2:7 doi:10.1186/1758-2946-2-7

Barry Hardy, Nicki Douglas, Christoph Helma, Micha Rautenberg, Nina Jeliazkova, Vedrin Jeliazkov, Ivelina Nikolova, Romualdo Benigni, OlgaTcheremenskaia, Stefan Kramer, Tobias Girschick, Fabian Buchwald, Joerg Wicker, Andreas Karwath, Martin Gutlein, Andreas Maunz, Haralambos Sarimveis, Georgia Melagraki, Antreas Afantitis, Pantelis Sopasakis, David Gallagher, Vladimir Poroikov, Dmitry Filimonov, Alexey Zakharov, Alexey Lagunin, Tatyana Gloriozova, Sergey Novikov, Natalia Skvortsova, Dmitry Druzhilovsky, Sunil Chawla, Indira Ghosh, Surajit Ray, Hitesh Patel and Sylvia Escher

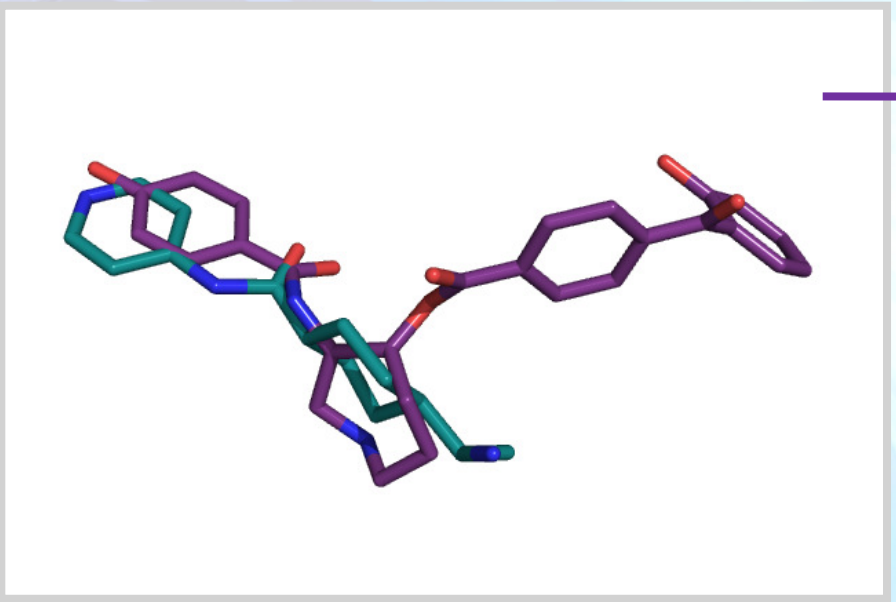
Open Access publication available at
www.jcheminf.com/content/2/1/7

Most accessed paper in last year!

OpenTox

Satisfying REACH Information Gathering Requirements

Input Structure



VO

Out - Toxic or Not?

- LD50
- Liver Toxicity
- Secondary Metabolites
- Bioavailability
- Mutagenicity
- Carcogenicity
- ReproductiveToxicology
- Skin Irritation
- Aqua Toxicity
- Combined predictions for arrays of mutiple end points

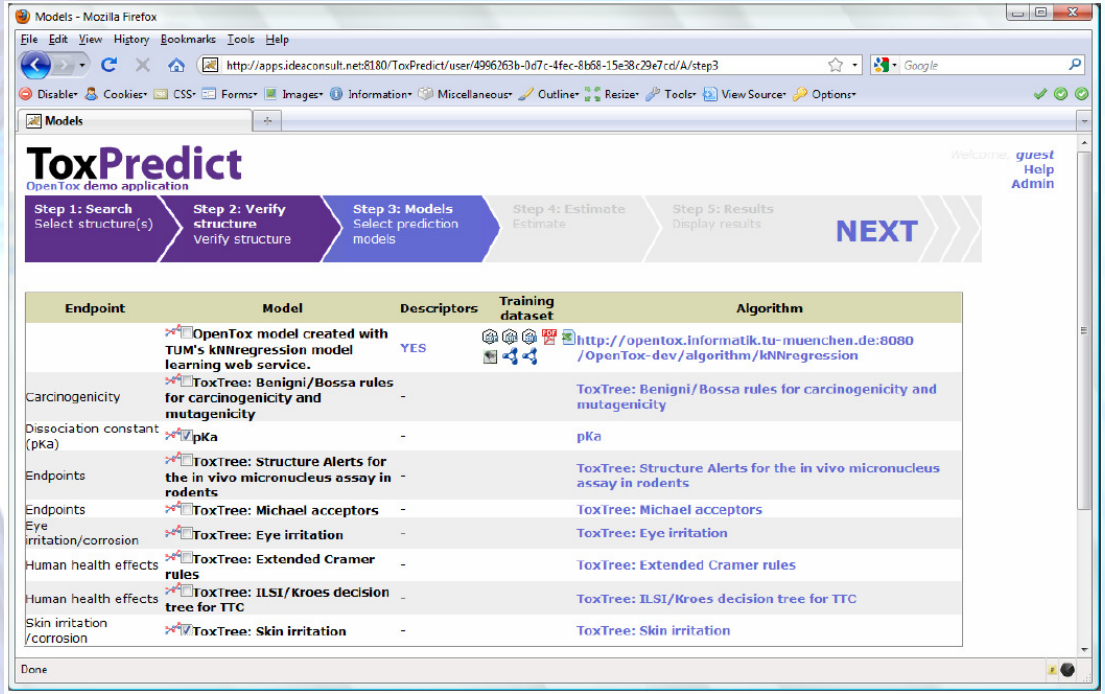
REACH
(enRegistrement, Evaluation et Autorisation des substances CHimiques)

Driver

Increasing demands on industry to satisfy safety evaluation and risk assessment required by REACH legislation. (Over 140k cmpds registered).

OpenTox

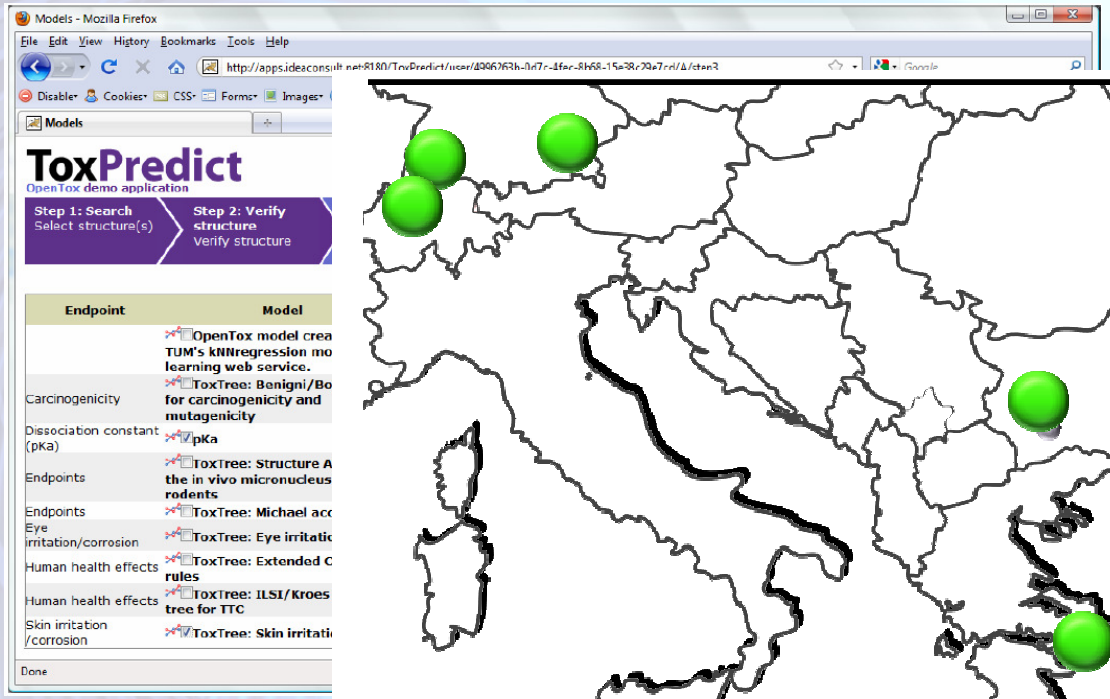
With OpenTox approach to standards you can reliably gather information from multiple resources in real time...



Simple building of predictive toxicology applications based on well-established methods and databases

ToxPredict Developed by Ideaconsult

ToxPredict accesses linked resources ...



Simple bui

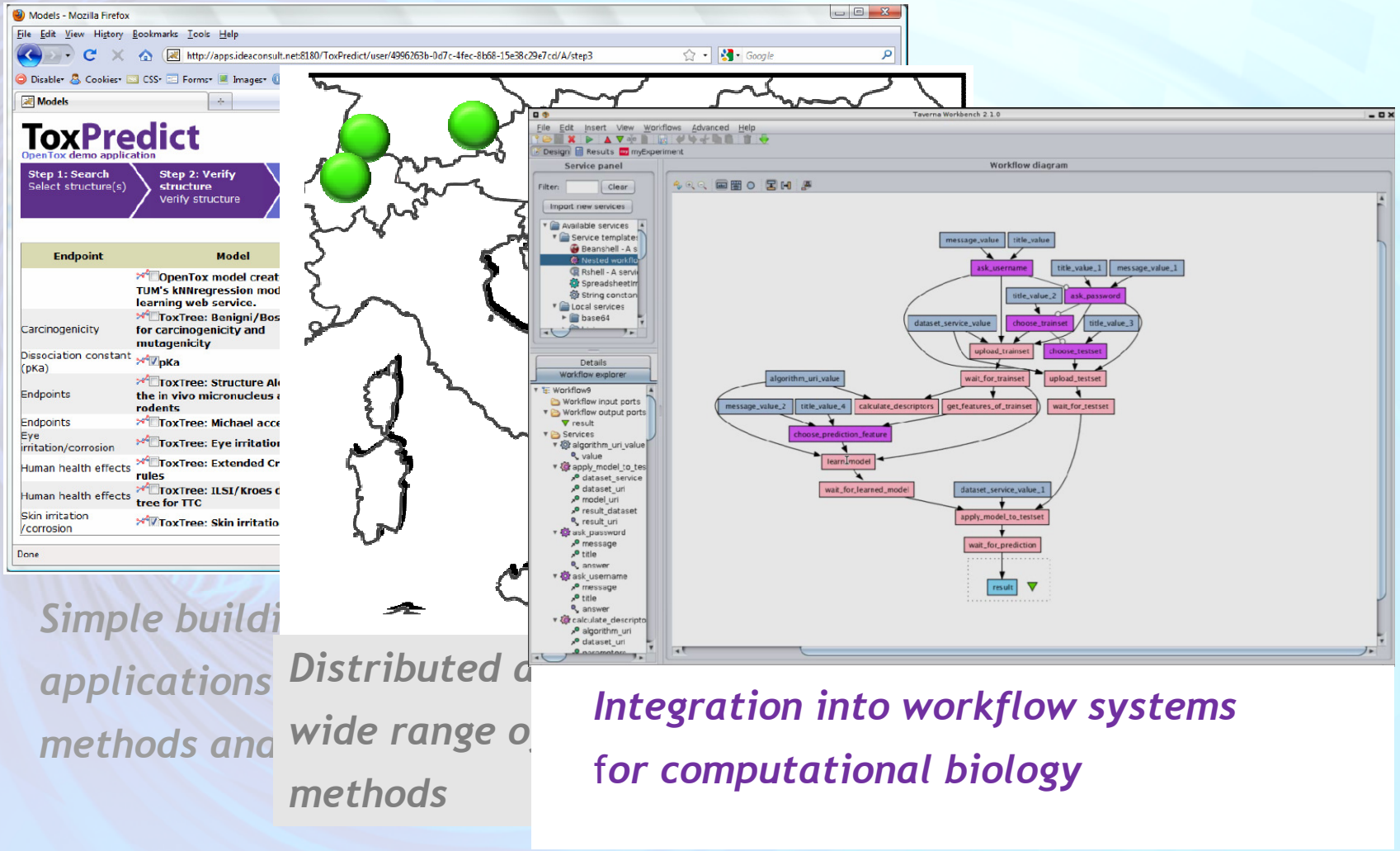
applicatio

methods a

Distributed applications, integrating wide range of data, models, prediction methods

OpenTox

Or Taverna workflows can be run for more complex tasks..



Simple buildi
applications
methods and

Distributed a
wide range o
methods

Integration into workflow systems for computational biology

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A Toxicology Ontology Roadmap

Submitted 31 Aug 2011: Barry Hardy (Douglas Connect and OpenTox), Gordana Apic (Cambridge Cell Networks), Philip Carthew (Unilever), Dominic Clark (EMBL-EBI), David Cook (AstraZeneca), Ian Dix (AstraZeneca & Pistoia Alliance), Sylvia Escher (Fraunhofer Institute for Toxicology & Experimental Medicine), Janna Hastings (EMBL-EBI), David J. Heard (Novartis), Nina Jeliazkova (Ideaconsult), Philip Judson (Lhasa Ltd.), Sherri Matis-Mitchell (AstraZeneca), Dragana Mitic (Cambridge Cell Networks), Glenn Myatt (Leadscope), Imran Shah (US EPA), Ola Spjuth (University of Uppsala), Olga Tcheremenskaia (Istituto Superiore di Sanità), Luca Toldo (Merck KGaA), David Watson (Lhasa Ltd.), Andrew White (Unilever), Chihae Yang (Altamira)

Based on Proceedings from the **Toxicology Ontology Roadmap Workshop**

EMBL-EBI Industry Programme Workshop

16 -17th November 2010, Hinxton, UK

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OpenTox – CADASTER Collaboration

CADASTER web site uses applicability domain and substructure / similarity search facilities via the OpenTox API compliant web services, running at
apps.ideaconsult.net:8080/ambit2

The applicability domain algorithms used are:
apps.ideaconsult.net:8080/ambit2/algorithm?type=AppDomain

The results are displayed integrated within the Cadaster web database
www.cadaster.eu/database/static/home.do

OpenTox – CADASTER Collaboration

Planned Developments:

1. Providing an OpenTox API wrapper for CADASTER Soap web services (Nina Jeliazkova, Ideaconsult)

2. Integrating CADASTER models in ToxPredict, via the OpenTox API wrapper (Nina Jeliazkova, Ideaconsult)

3. Provide access to selection of OpenTox models via CADASTER web site
   (Igor Tetko, Helmholtz Centre Munich)

REACH Requirements

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REACH and (Q)SAR bottlenecks

Wim De Coen, ECHA, "*Current Challenges from Evaluation Point of View – Introduction Case Studies*", ECHA Experts Workshop on "Dealing with Uncertainty of Non-Test Methods under REACH" (2010):

Specific Bottlenecks for (Q)SAR:

- Well standardized and accepted OECD principles
- Issues mainly at level of documentation
  - Level of documentation insufficient
    - QMRF, QPRF missing
  - Applicability domain unclear
  - Unclear training datasets & algorithm
    - General issue of lack of well established (Q)SAR software

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REACH and data bottlenecks

There exists considerable uncertainty in decision making based on current reproductive toxicity data, which place the largest potential demands on animal testing required by REACH.

Improvements to reduce uncertainty in decision making require:
a "robust reference dataset of harmonised test information"

Reference: Dick Sijm and Betty Hakkert, RIVM, *"Use of non-test methods in integrated testing strategies for making informed decisions - Non-test methods require robust reference datasets"*, ECHA Experts Workshop on "Dealing with Uncertainty of Non-Test Methods under REACH", 2010)

OpenTox

(Q)SARs & REACH requirements

(Quantitative) Structure Activity Relationship = (Q)SAR

According to REACH Annex XI, (Q)SAR results may be used instead of testing when all of the following conditions are met:

- The results are derived from a (Q)SAR model whose scientific validity has been established.
- The substance falls within the applicability domain of the (Q)SAR model.
- The results are adequate for the purpose of classification and labeling and/or risk assessment.
- Adequate and reliable documentation of the applied method is provided.

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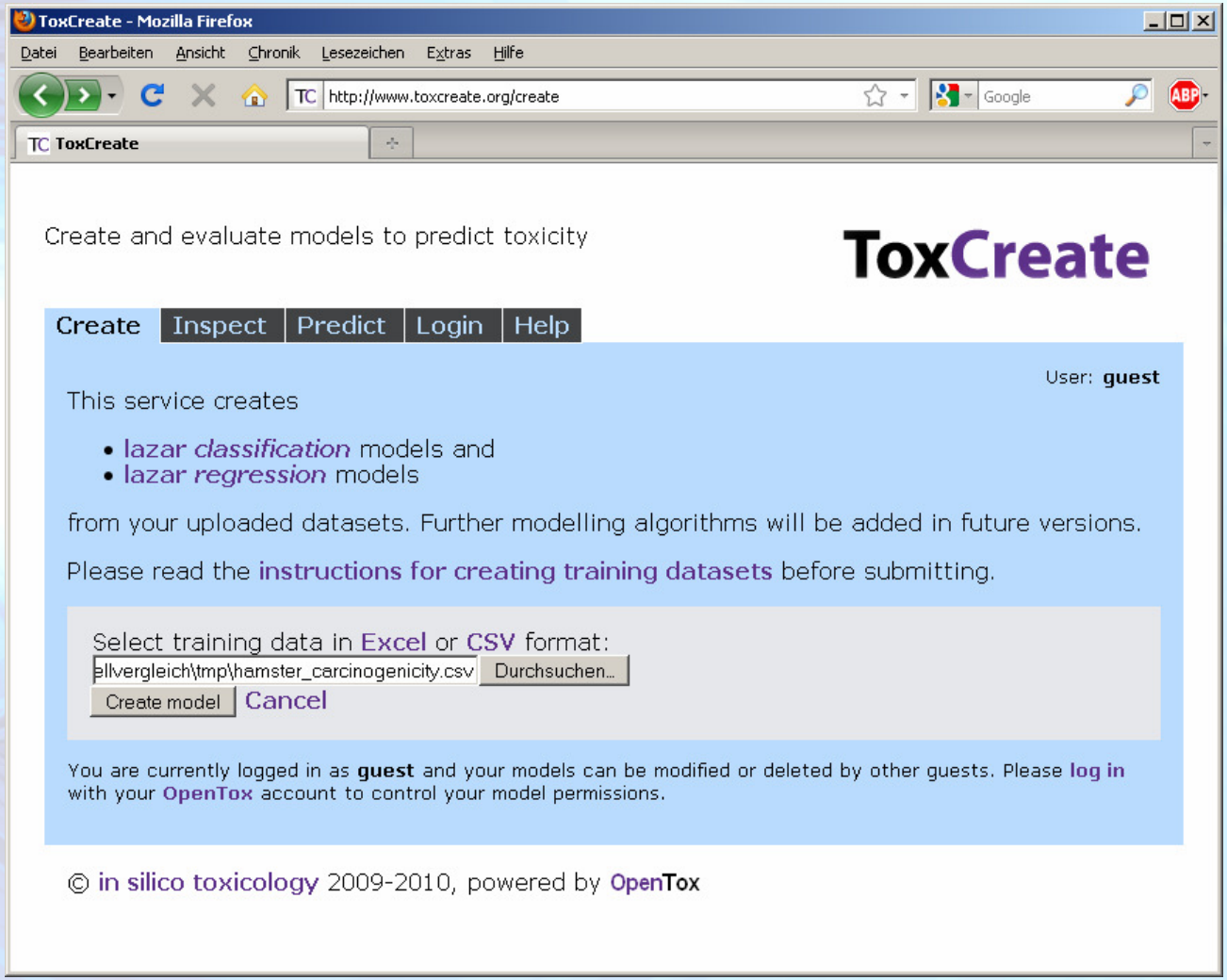
ToxCreate - (Q)SAR Model Building application



www.ToxCreate.org developed by In Silico Toxicology

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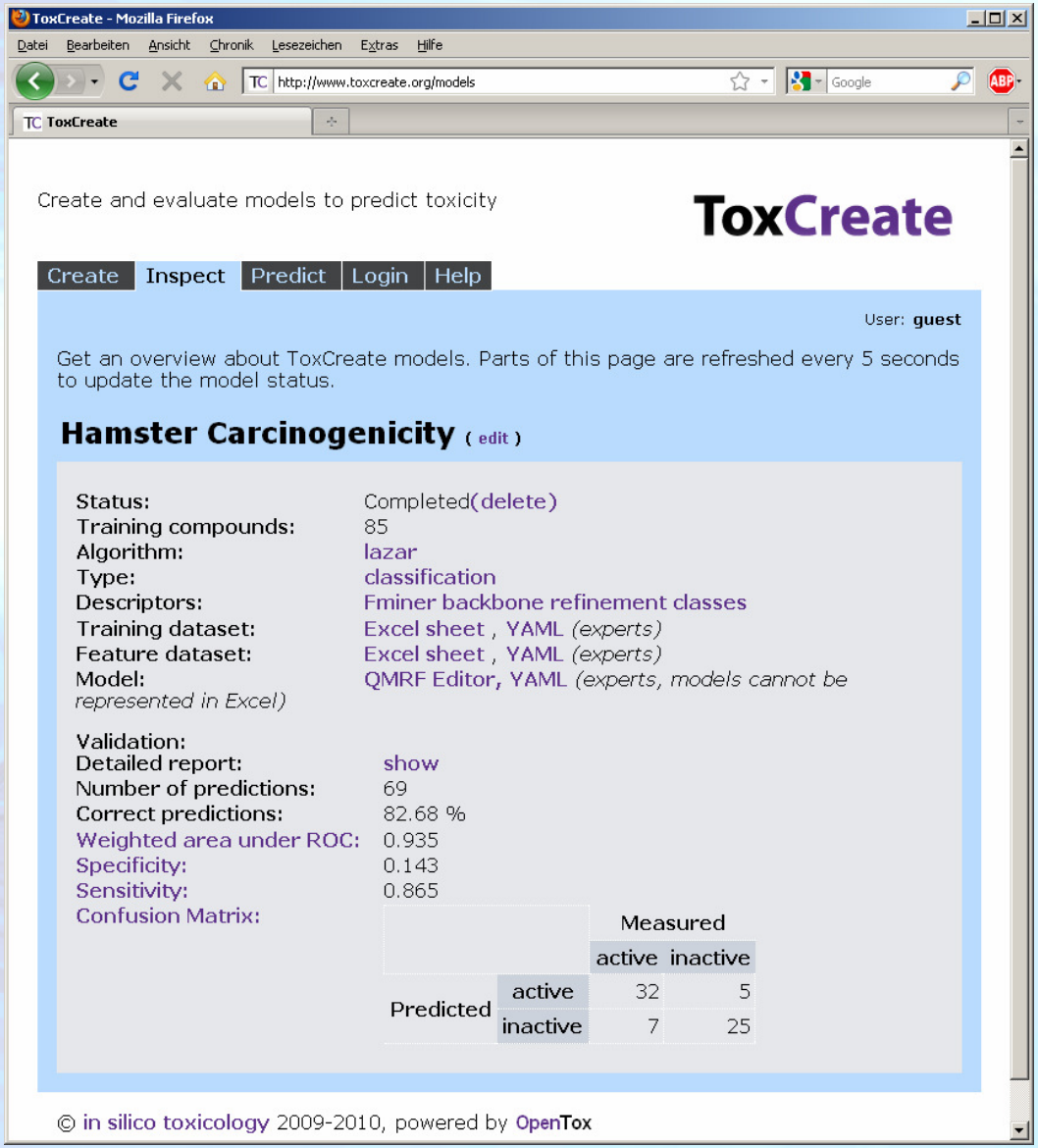
ToxCreate - (Q)SAR Model Results



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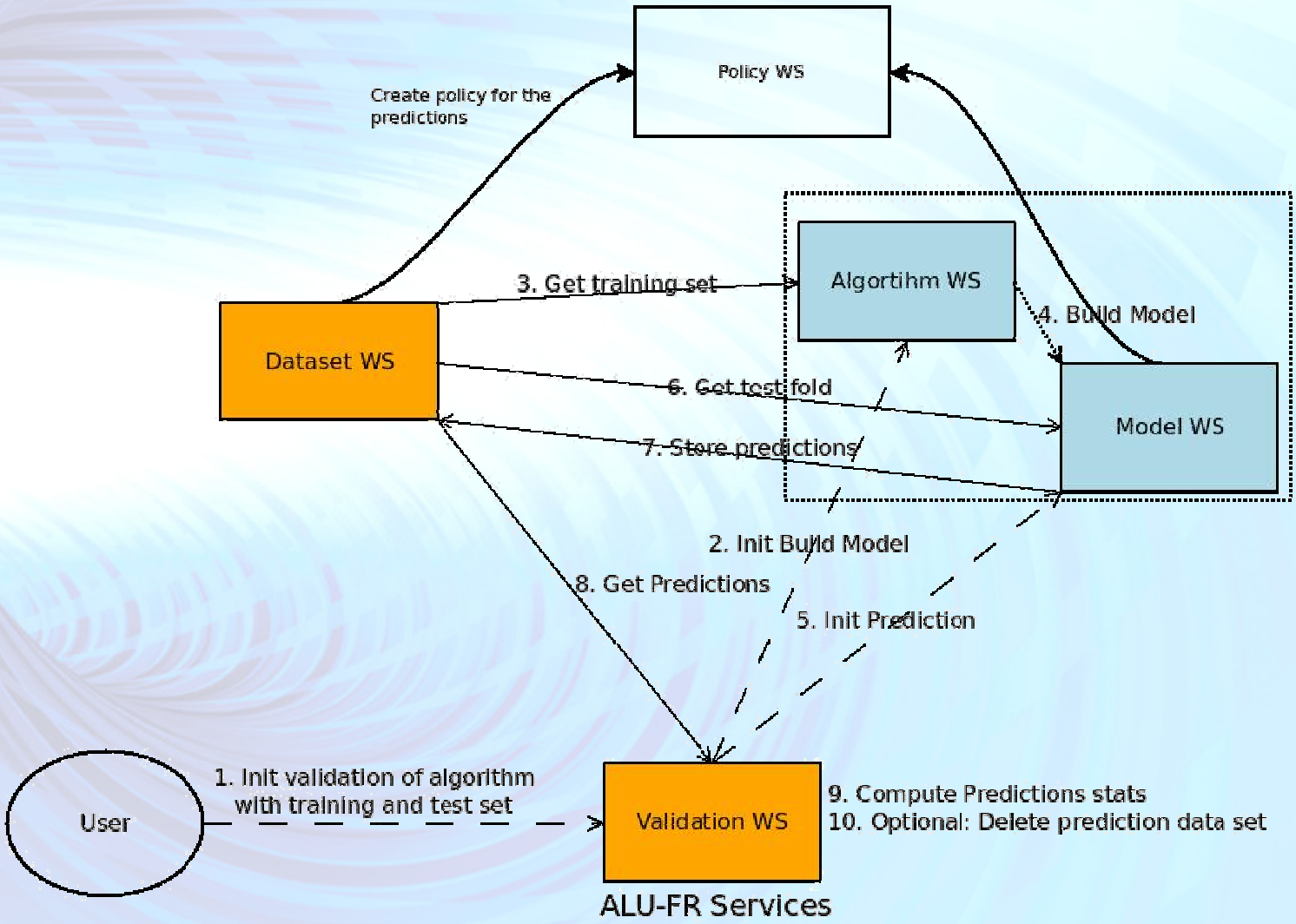
	OECD Principle	OpenTox addresses Validation Principles by...
1	Defined Endpoint	providing a unified source of well defined and documented toxicity data with a common vocabulary
2	Unambiguous Algorithm	providing transparent access to well documented models and algorithms as well as to the source code
3	Defined Applicability Domain	integrating tools for the determination of applicability domains during the validation of prediction models
4	Goodness-of-fit, robustness and predictivity	providing scientifically sound validation routines for the determination of errors and confidences
5	Mechanistic interpretation (if possible)	integrating tools for the inference, correlation or prediction of toxicological mechanisms and the recording of opinions and analysis in reports

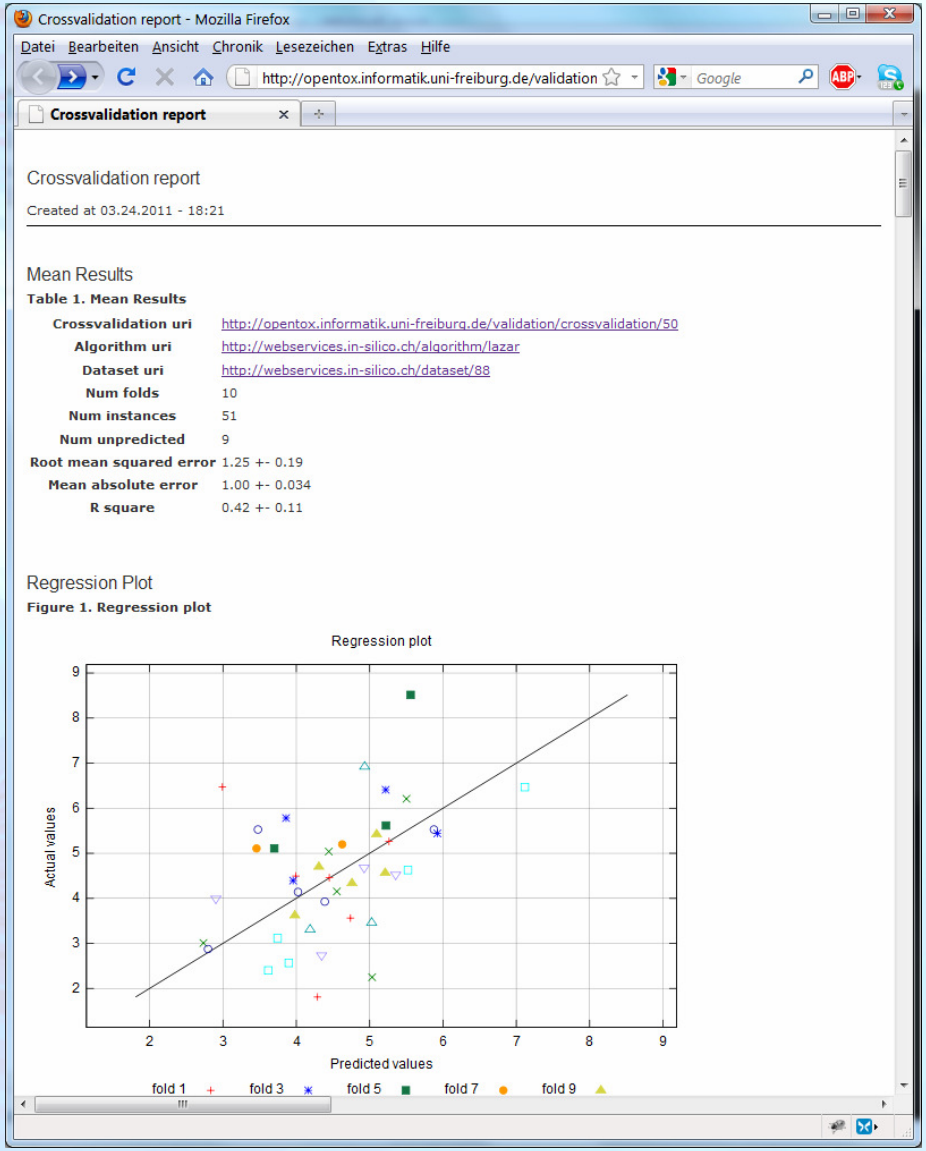
OpenTox

Validation within OpenTox

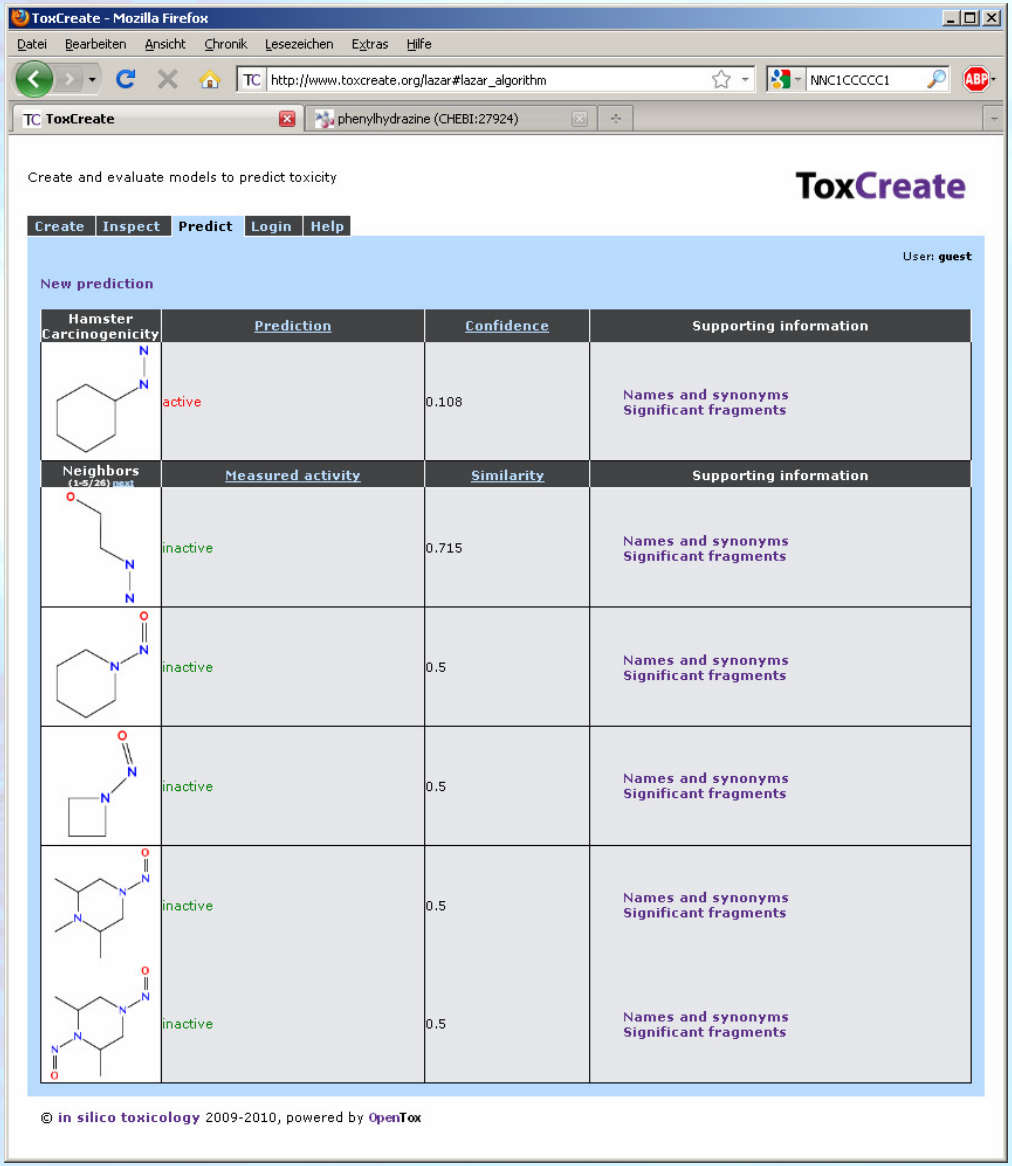


OpenTox

ToxCreate - linked to Validation Service

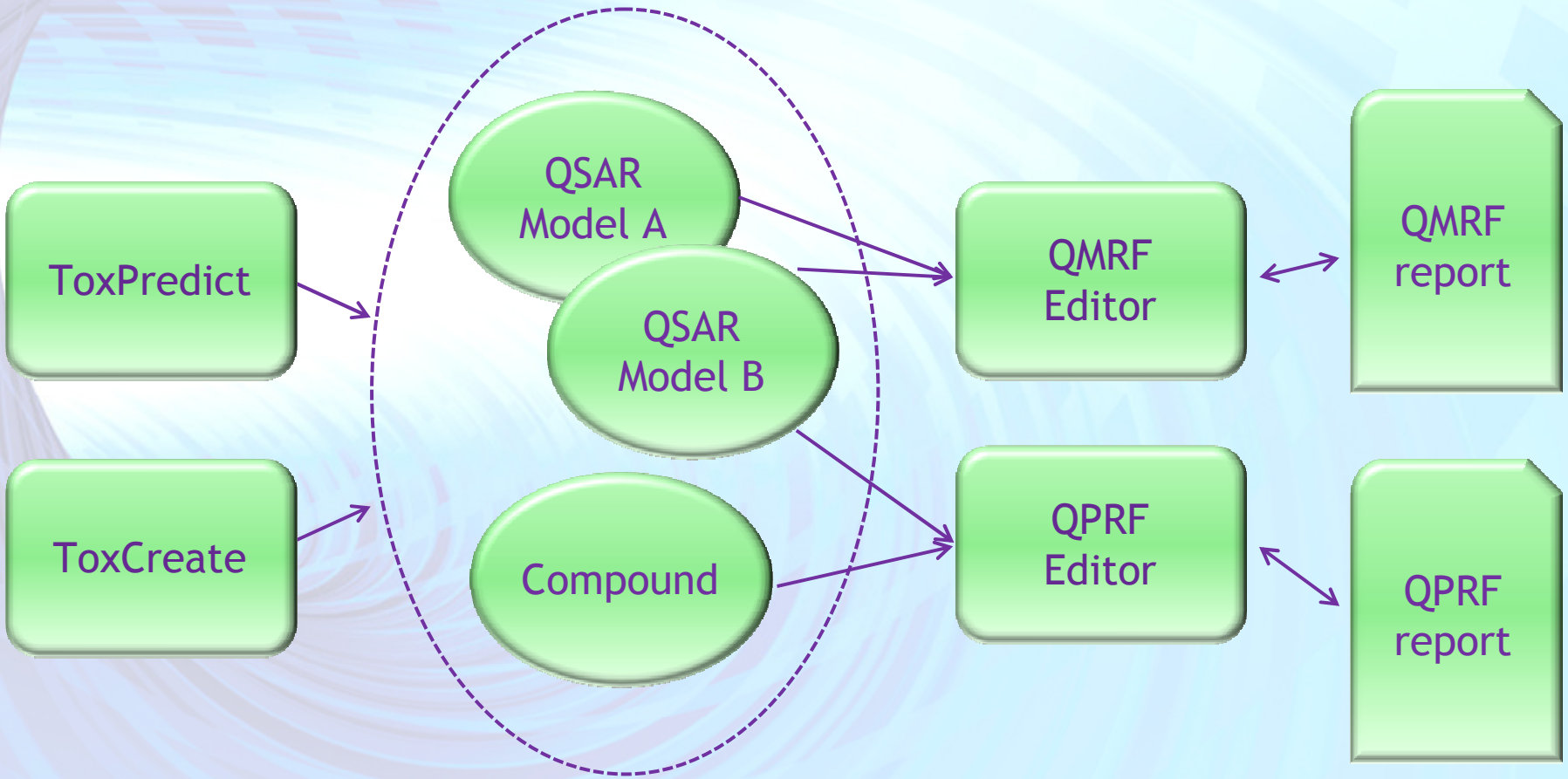


ToxCreate – Confidence, Supporting Information



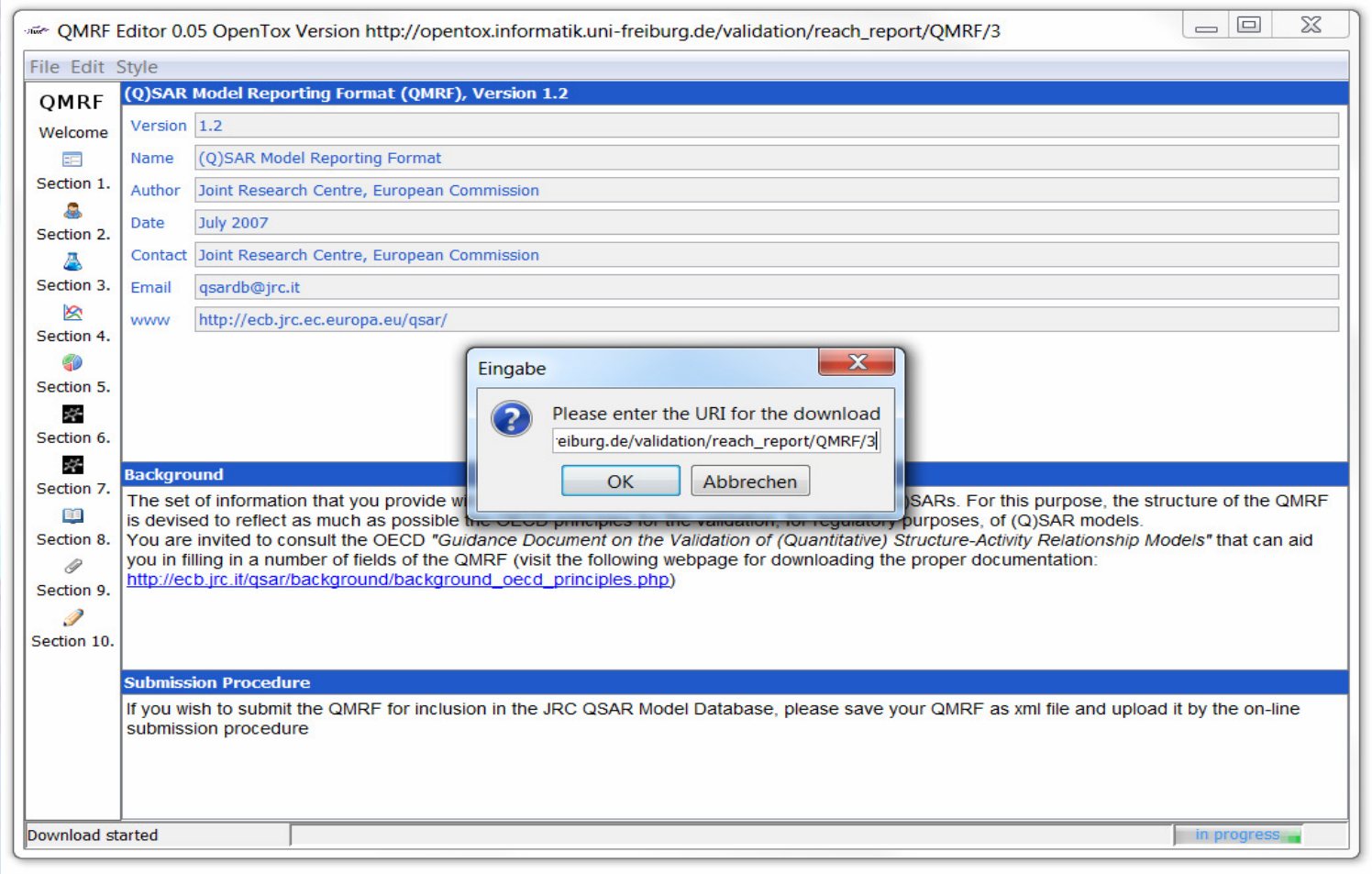
OpenTox

(Q)SARs - reporting in OpenTox



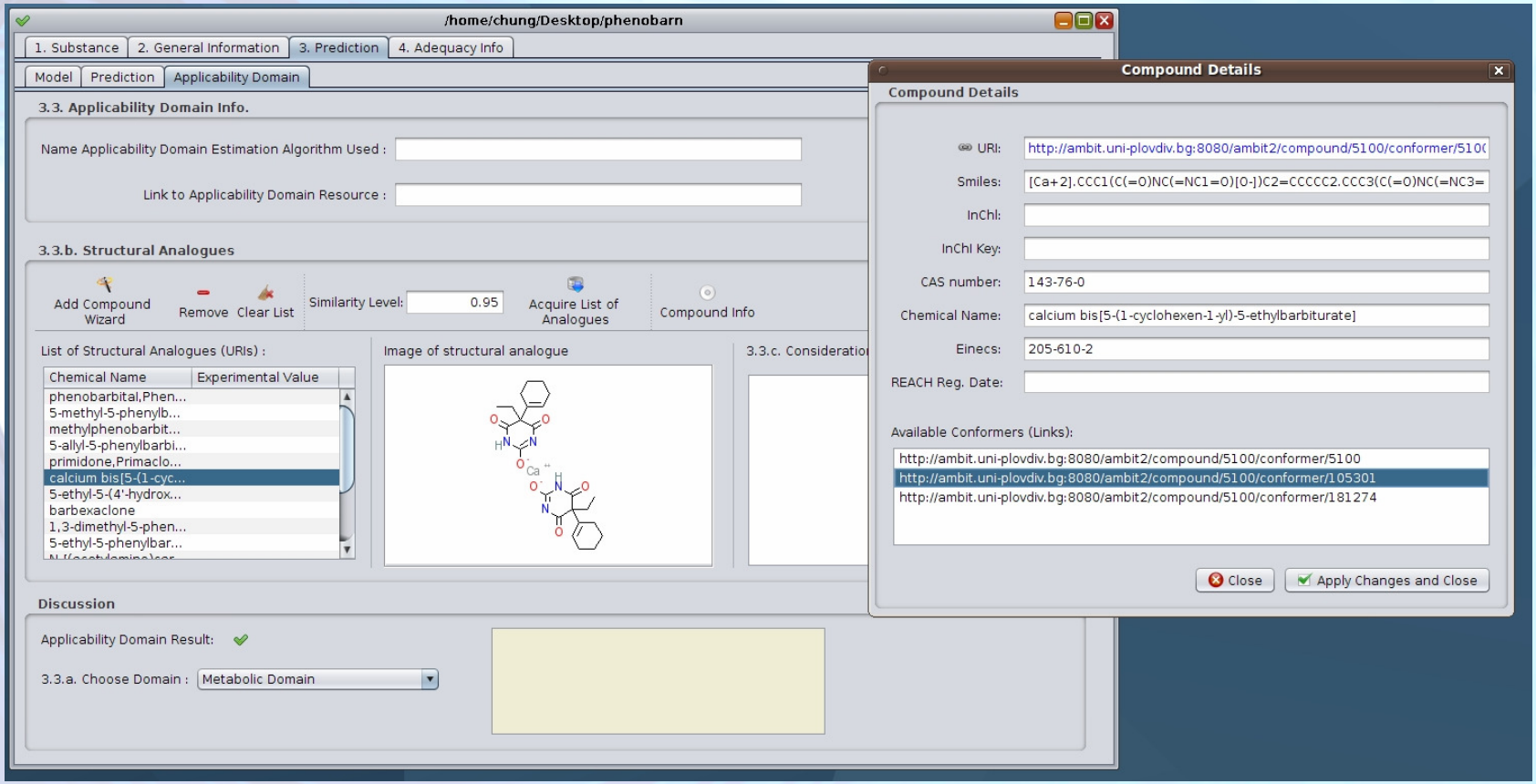
OpenTox

(Q)SARs - QMRF reporting in OpenTox



OpenTox

QPRF Reporting (Qedit)



Application by Pantelis Sopasakis (NTUA)

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Metabolites

According to ECHA Guidance B, further investigation may be required for degradation products and metabolites if considered relevant for the chemical safety assessment, PBT assessment or classification and labeling.

Metabolites, Metabolic Enzymatic induction and the creation of Reactive Intermediates may all lead to toxicity, e.g., in drug-drug interactions and hepatotoxic adverse events.

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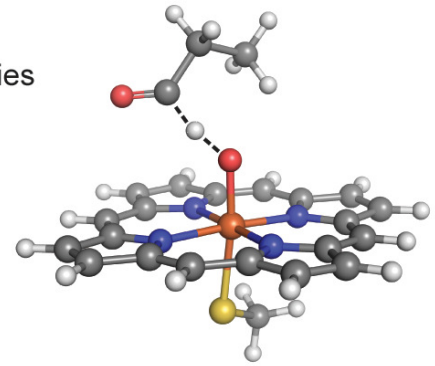
SMARTCyp Service for Predicting Metabolites

Atom Reactivity Library

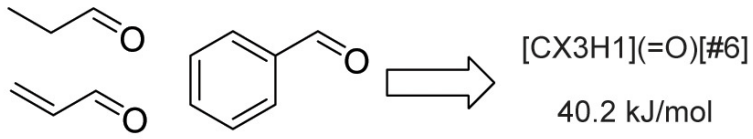
A. Calculate Quantum Chemical Reference Energies

Calculate transition state energies using density functional theory



B. Define SMARTS Rules

Group calculations by fragments and calculate average energies

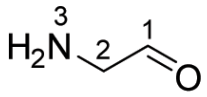


SMARTCyp – developed by Patrik Rydberg, University of Copenhagen

www.farma.ku.dk/index.php/SMARTCyp/7990/0/

SMARTCyp

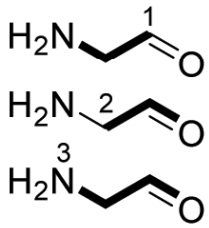
1. Assign Energies By SMARTS matching



Atom	SMARTS	Energy
1	[CX3H1](=O)[#6]	40.2
2	[CX4][N]	39.8
3	[N^3][H1,H2]	54.1

2. Compute Accessibility Descriptor

A_i = Maxbonds$_i$ / Maxbonds$_{all}$



A_1 = 2 / 3 = 0.67

A_2 = 2 / 3 = 0.67

A_3 = 3 / 3 = 1.00

3. Compute Score and Rank Atoms

Score, S = E - 8A
Lowest score gets rank 1

S_1 = 40.2 - 8*0.67 = 34.84

S_2 = 39.8 - 8*0.67 = 34.44

S_3 = 54.1 - 8*1.00 = 46.10

Atom 1 - Rank 2

Atom 2 - Rank 1

Atom 3 - Rank 3

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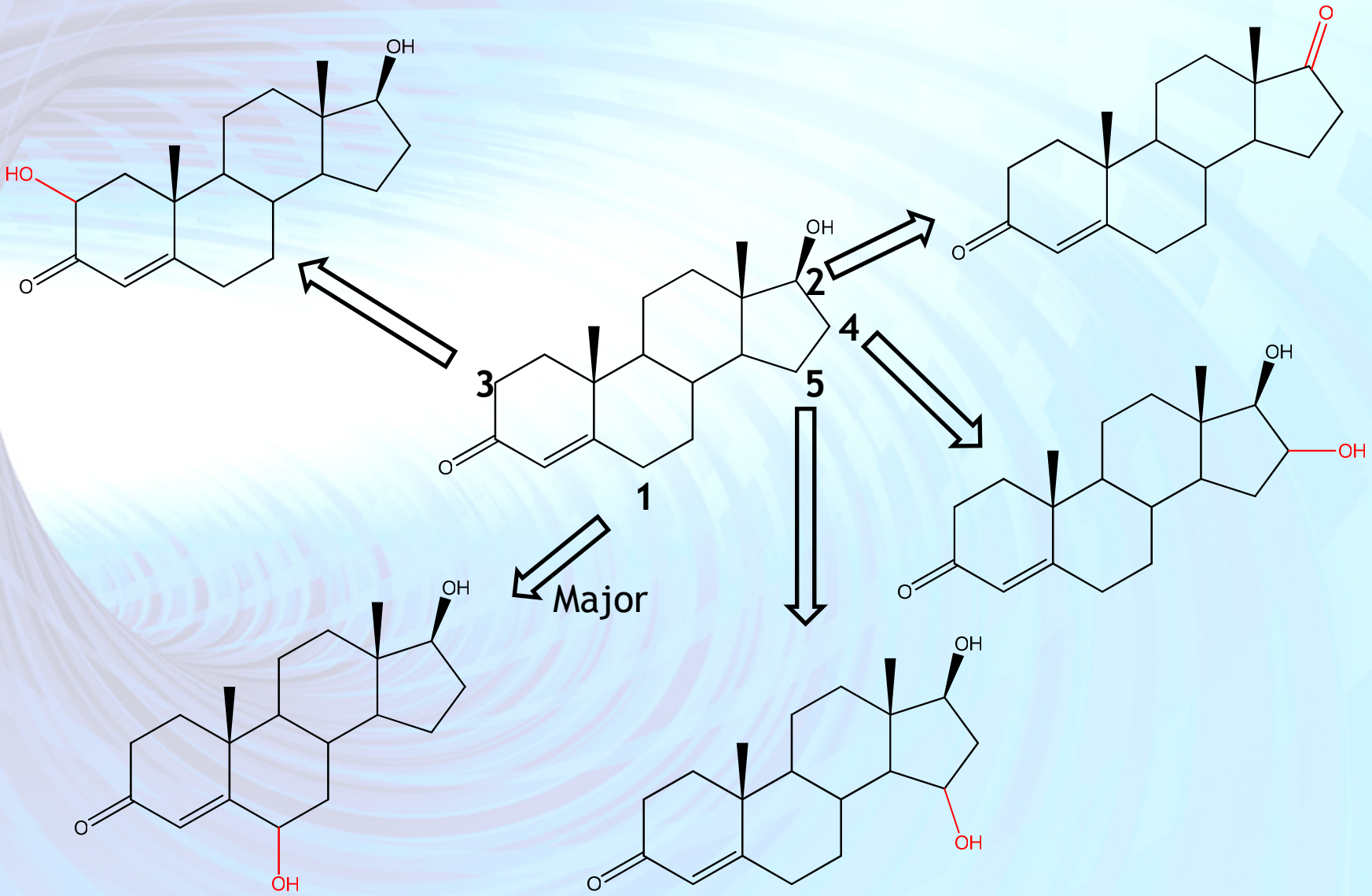
SmartCYP Prediction of Testosterone Metabolites



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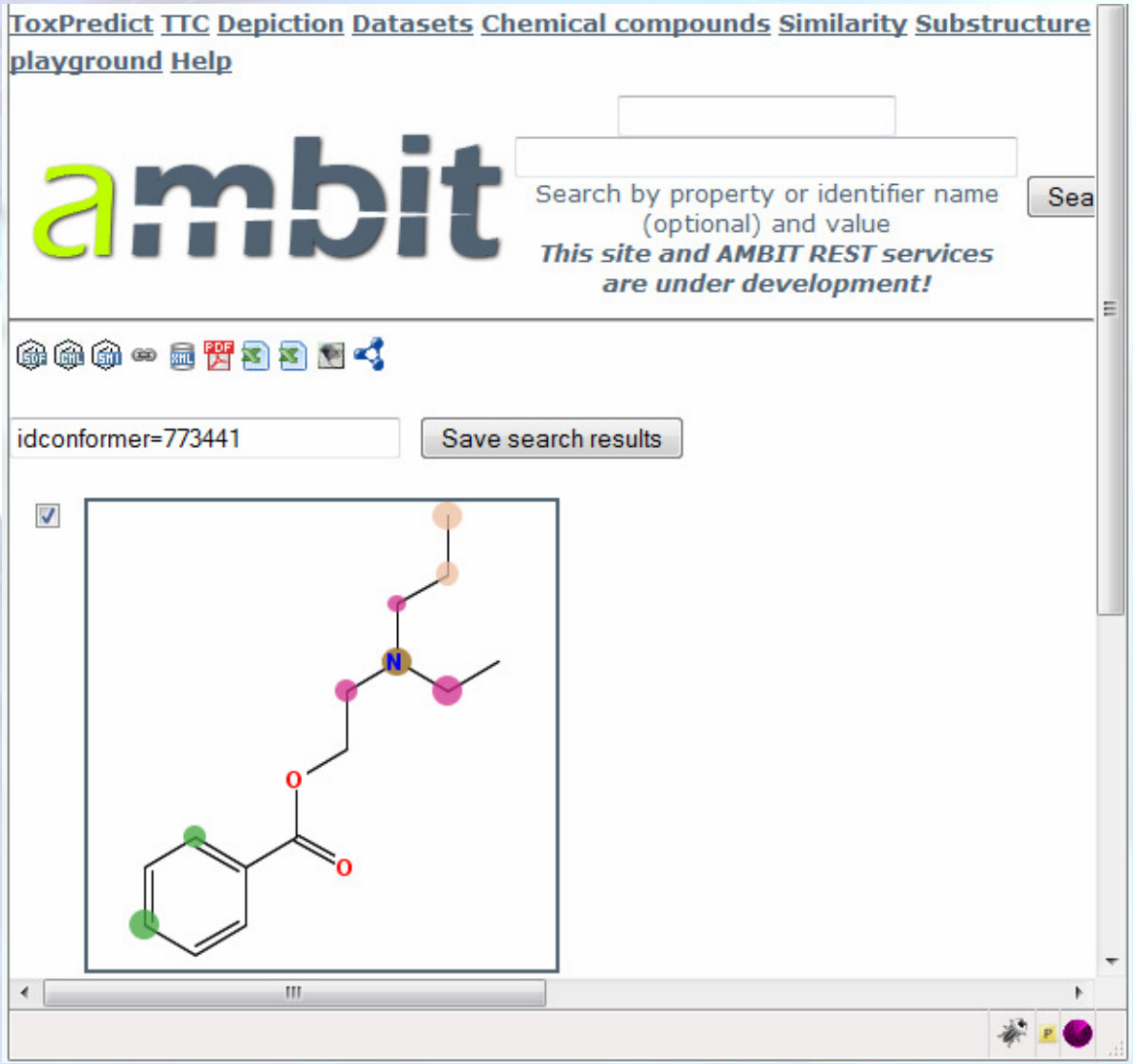
Metabolites



Aliphatic Hydroxylation

Aromatic Hydroxylation

N-Dealkylation

N-Oxidation

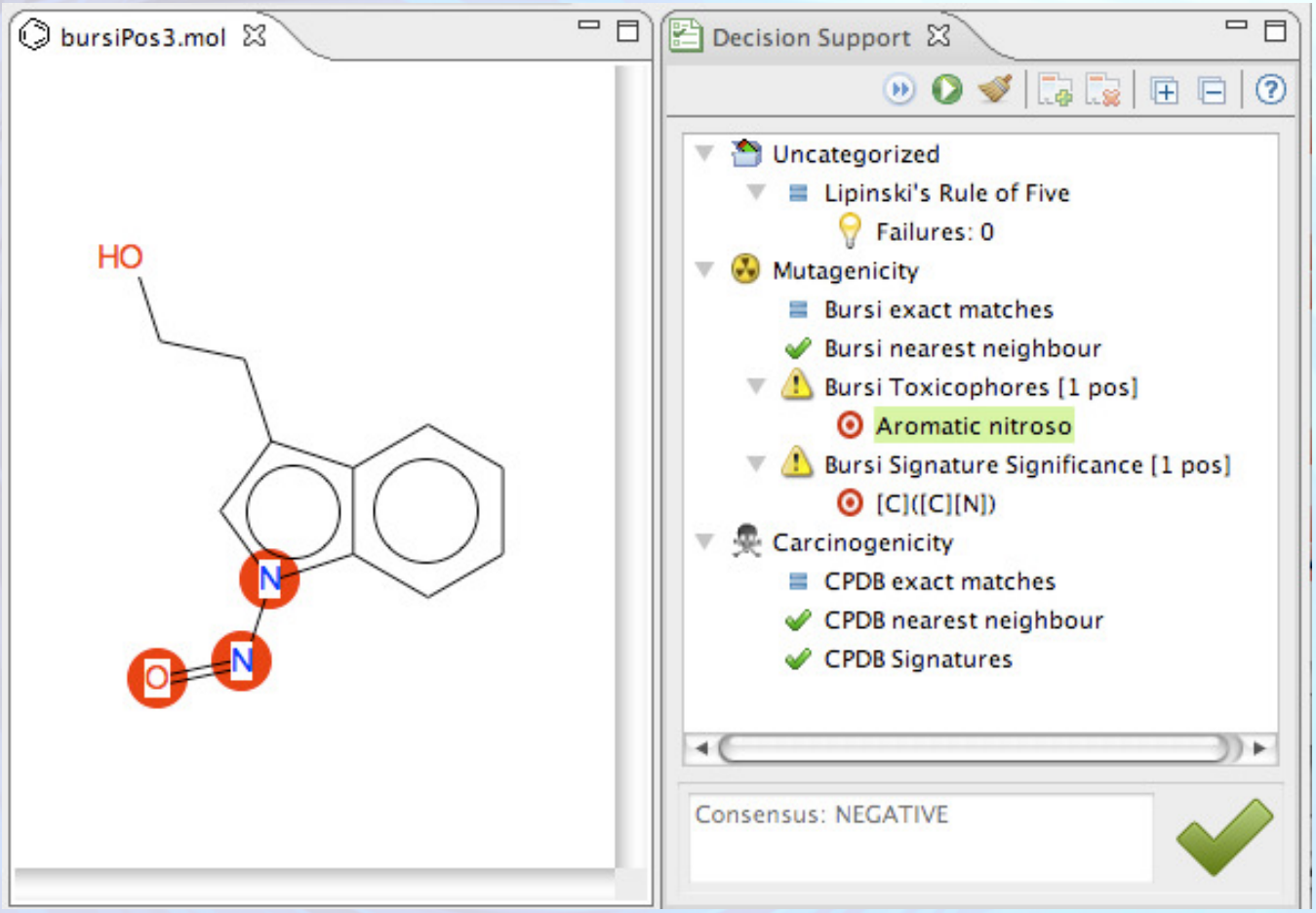
O-Dealkylation

S-Oxidation

Developed by Ideaconsult

OpenTox

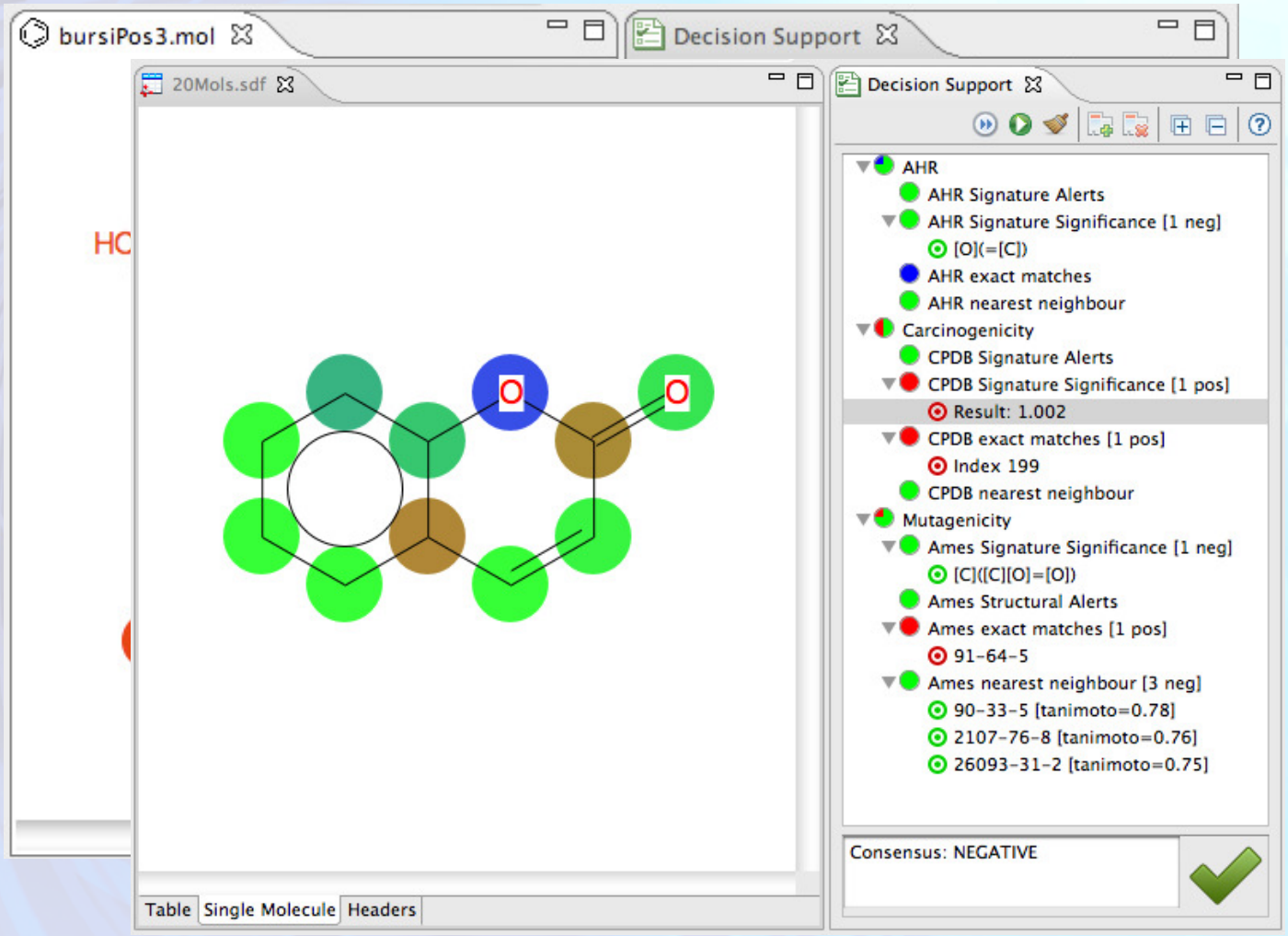
Bioclipse Visualisation Workbench



O. Spjuth, L. Carlsson, M. Eklund, E. Ahlberg Helgee, and Scott Boyer.
Integrated decision support for assessing chemical liabilities.

OpenTox

Bioclipse Visualisation Workbench



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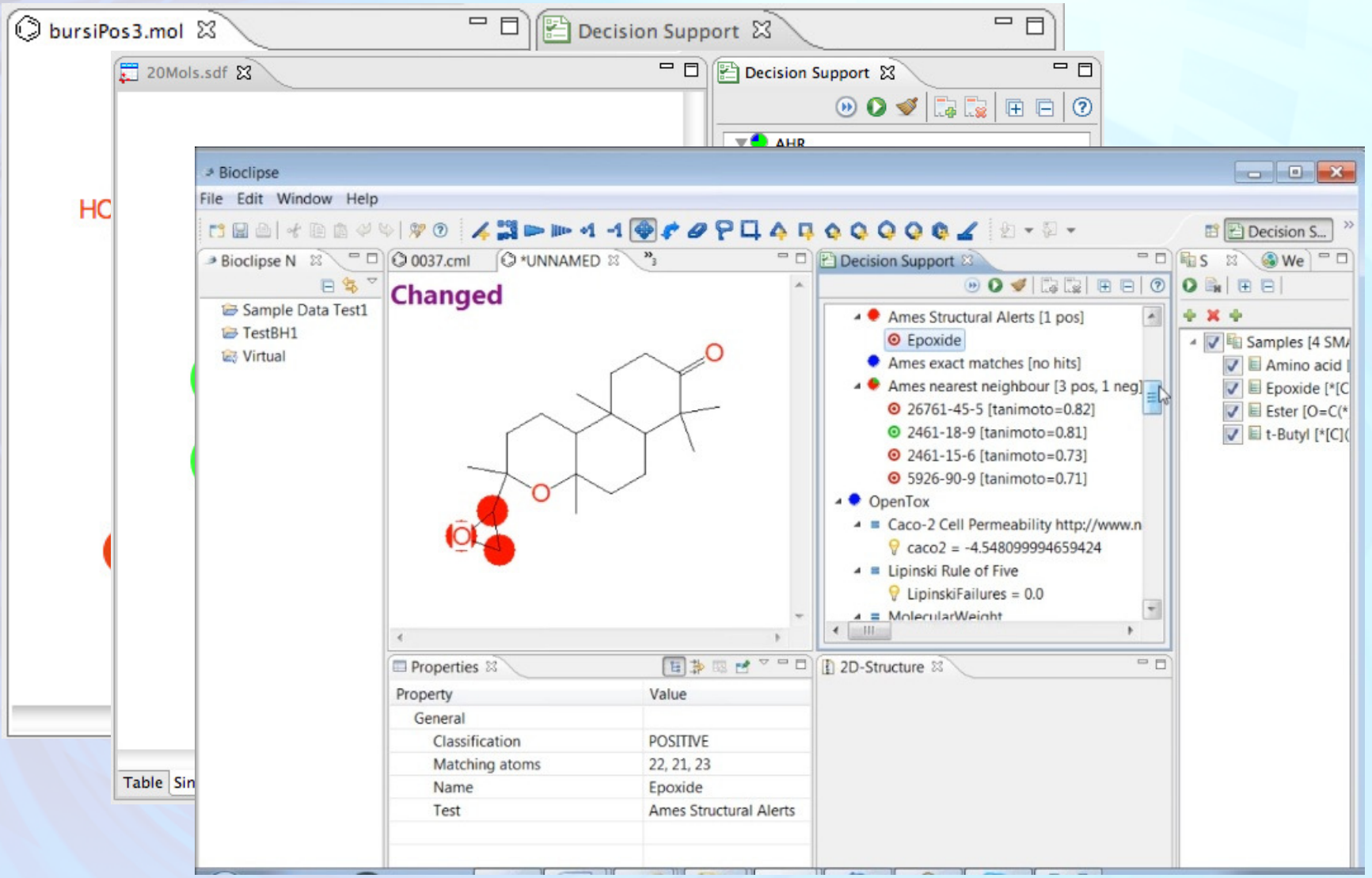
OpenTox

Bioclipse Visualisation Workbench - OpenTox



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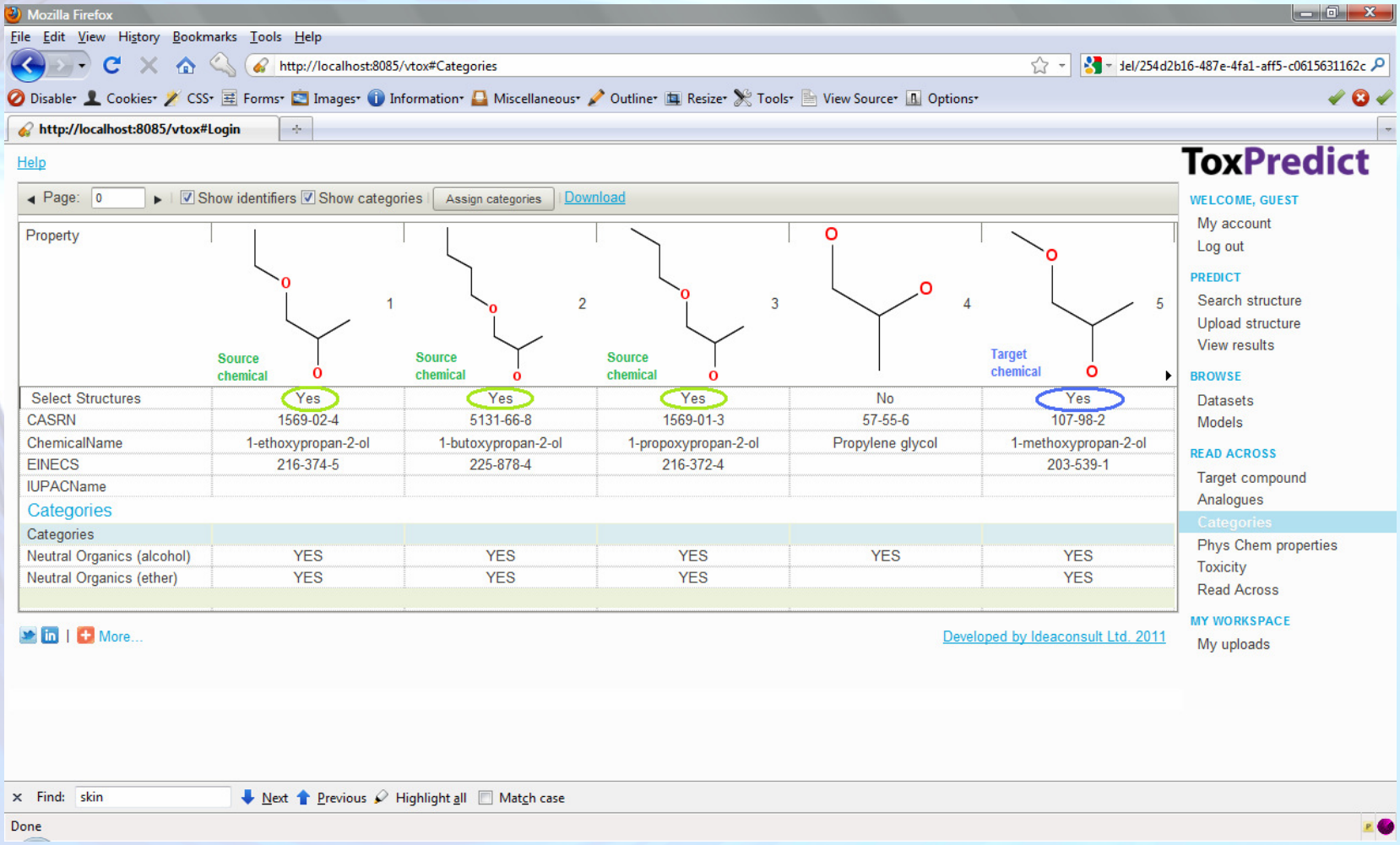
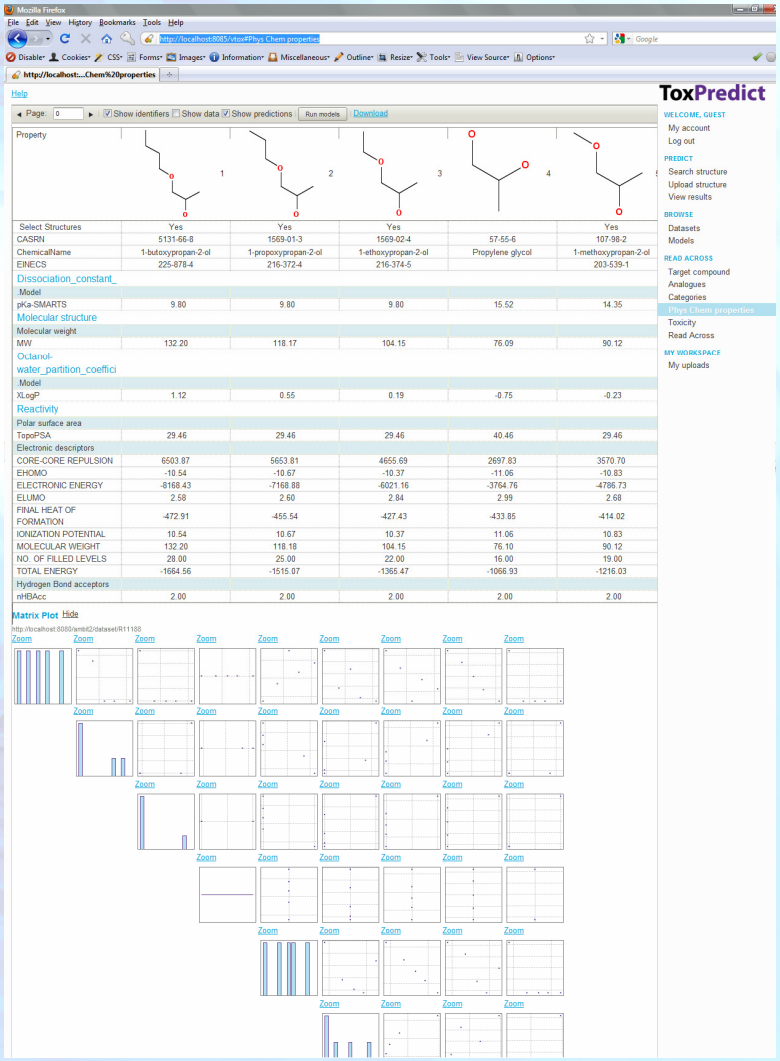
Integrated decision support for assessing chemical liabilities.

Read-Across Application



Extension of ToxPredict to Read Across by Nina Jeliazkova (Ideaconsult)

Read-Across Application



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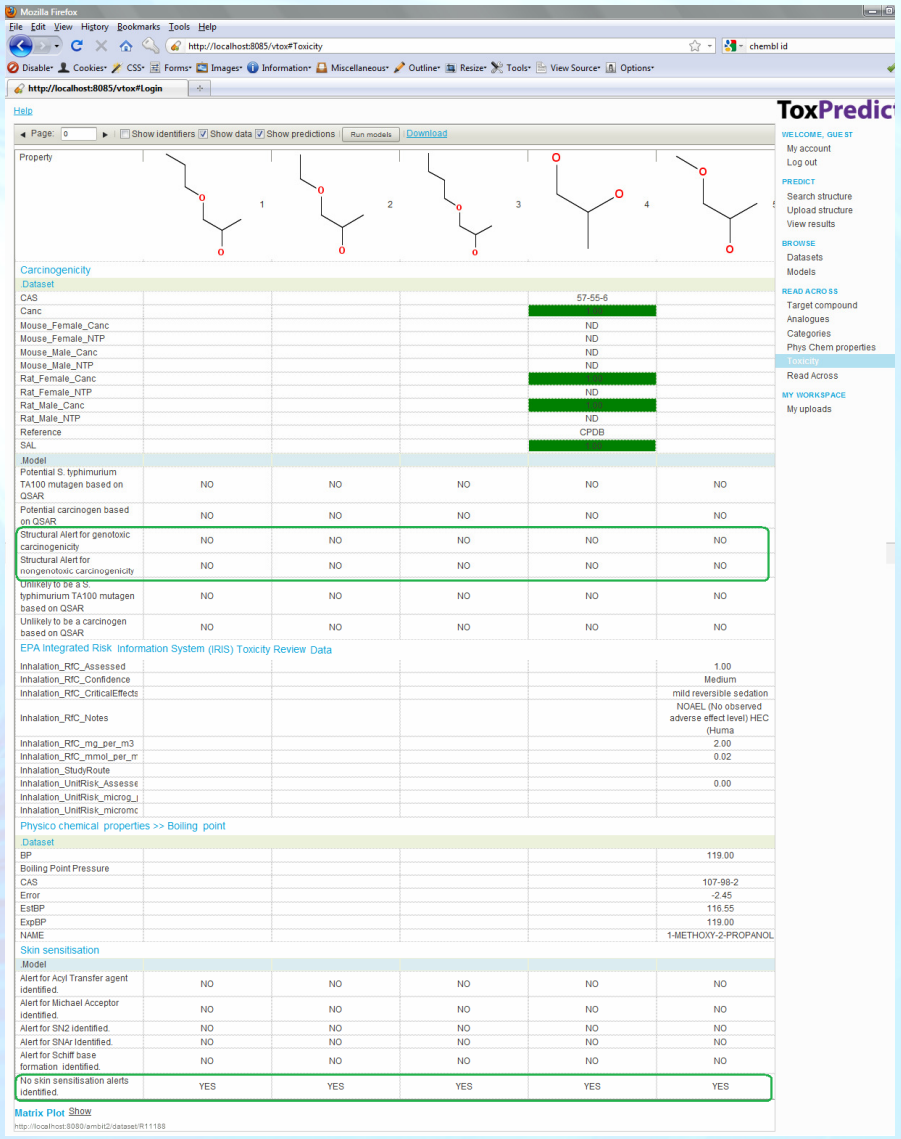
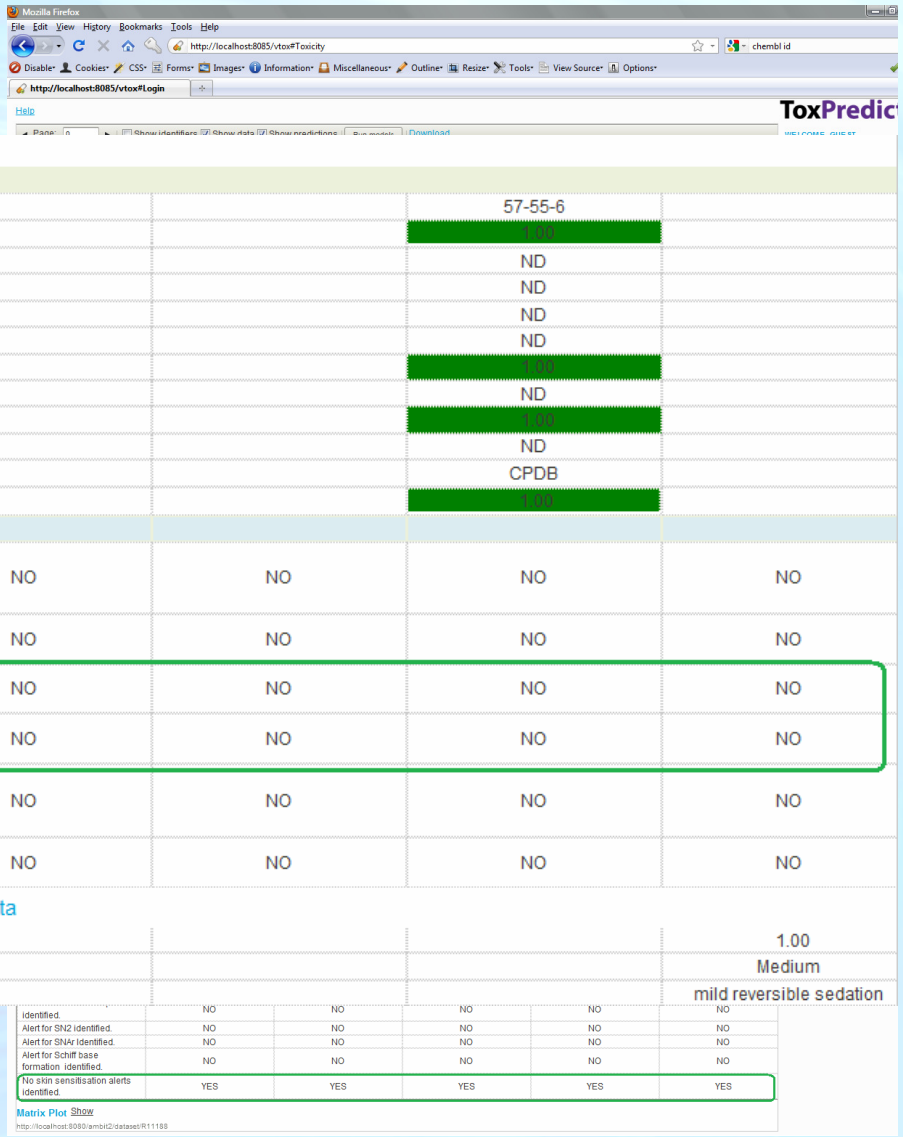
SEVENTH FRAMEWORK PROGRAMME

Read-Across Application



OpenTox

Read-Across Application



Carcinogenicity

.Dataset					
CAS				57-55-6	
Canc				1.00	
Mouse_Female_Canc				ND	
Mouse_Female_NTP				ND	
Mouse_Male_Canc				ND	
Mouse_Male_NTP				ND	
Rat_Female_Canc				1.00	
Rat_Female_NTP				ND	
Rat_Male_Canc				1.00	
Rat_Male_NTP				ND	
Reference				CPDB	
SAL				1.00	
.Model					
Potential S. typhimurium TA100 mutagen based on QSAR	NO	NO	NO	NO	NO
Potential carcinogen based on QSAR	NO	NO	NO	NO	NO
Structural Alert for genotoxic carcinogenicity	NO	NO	NO	NO	NO
Structural Alert for nongenotoxic carcinogenicity	NO	NO	NO	NO	NO
Unlikely to be a S. typhimurium TA100 mutagen based on QSAR	NO	NO	NO	NO	NO
Unlikely to be a carcinogen based on QSAR	NO	NO	NO	NO	NO

EPA Integrated Risk Information System (IRIS) Toxicity Review Data

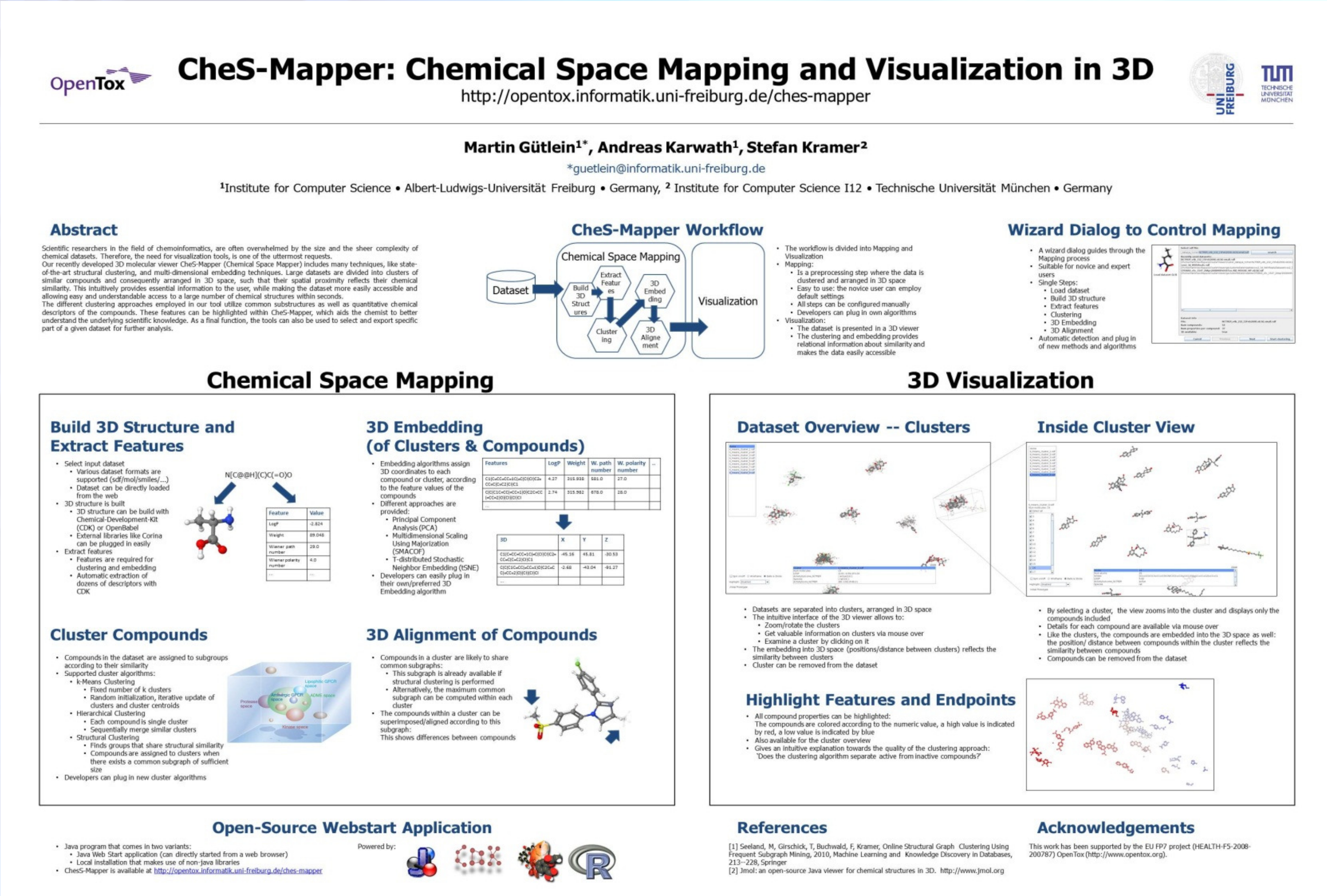
Inhalation_RfC_Assessed					1.00
Inhalation_RfC_Confidence					Medium
Inhalation_RfC_CriticalEffects					mild reversible sedation

identified.	NO	NO	NO	NO	NO
Alert for SN2 identified.	NO	NO	NO	NO	NO
Alert for SNAr identified.	NO	NO	NO	NO	NO
Alert for Schiff base formation identified.	NO	NO	NO	NO	NO
No skin sensitisation alerts identified.	YES	YES	YES	YES	YES

Matrix Plot Show

OpenTox

Chemical Space Visualisation (Ches-Mapper)

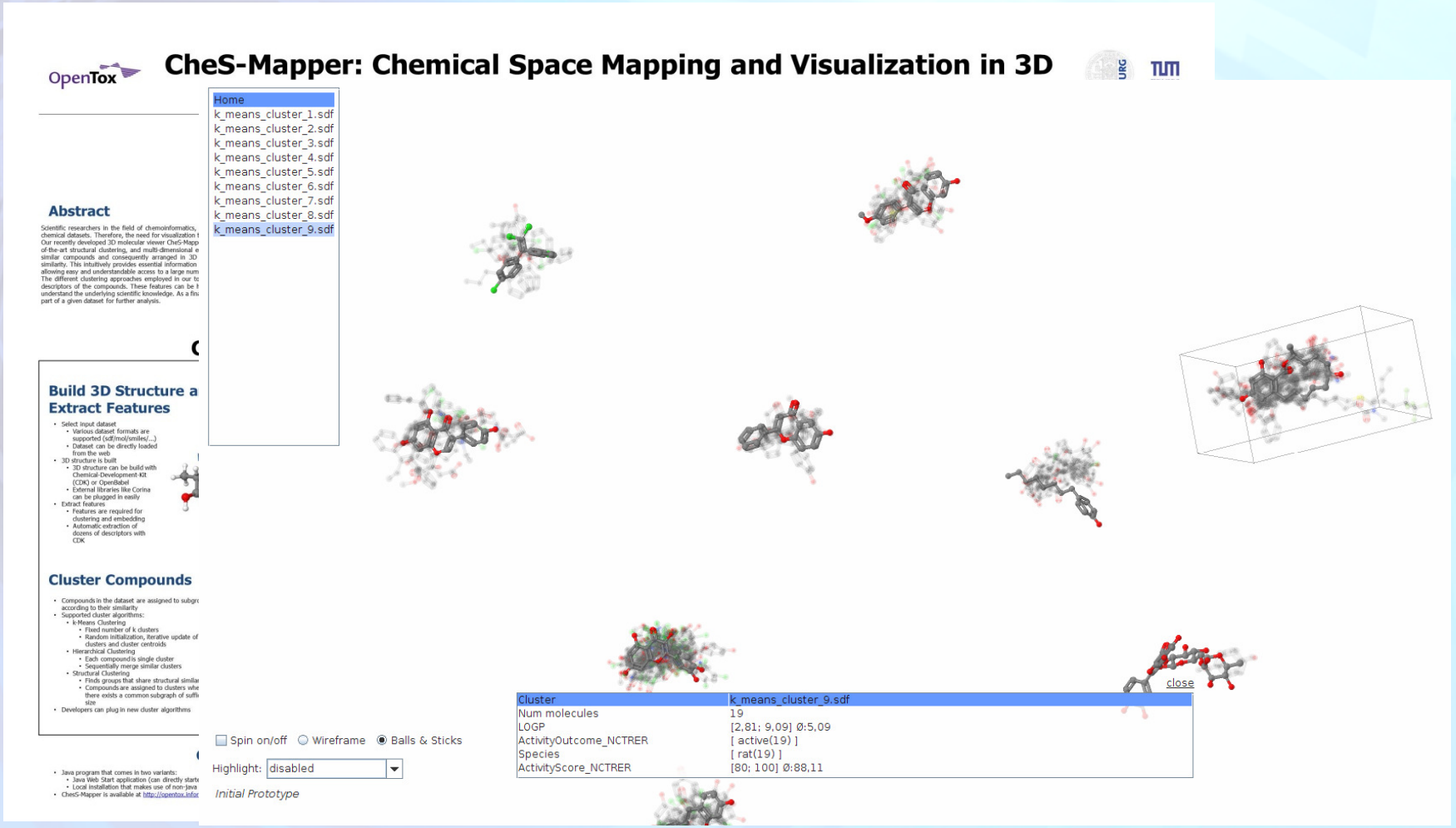


Developed by Martin Gütlein, Andreas Karwath, Stefan Kramer (ALU & TUM)

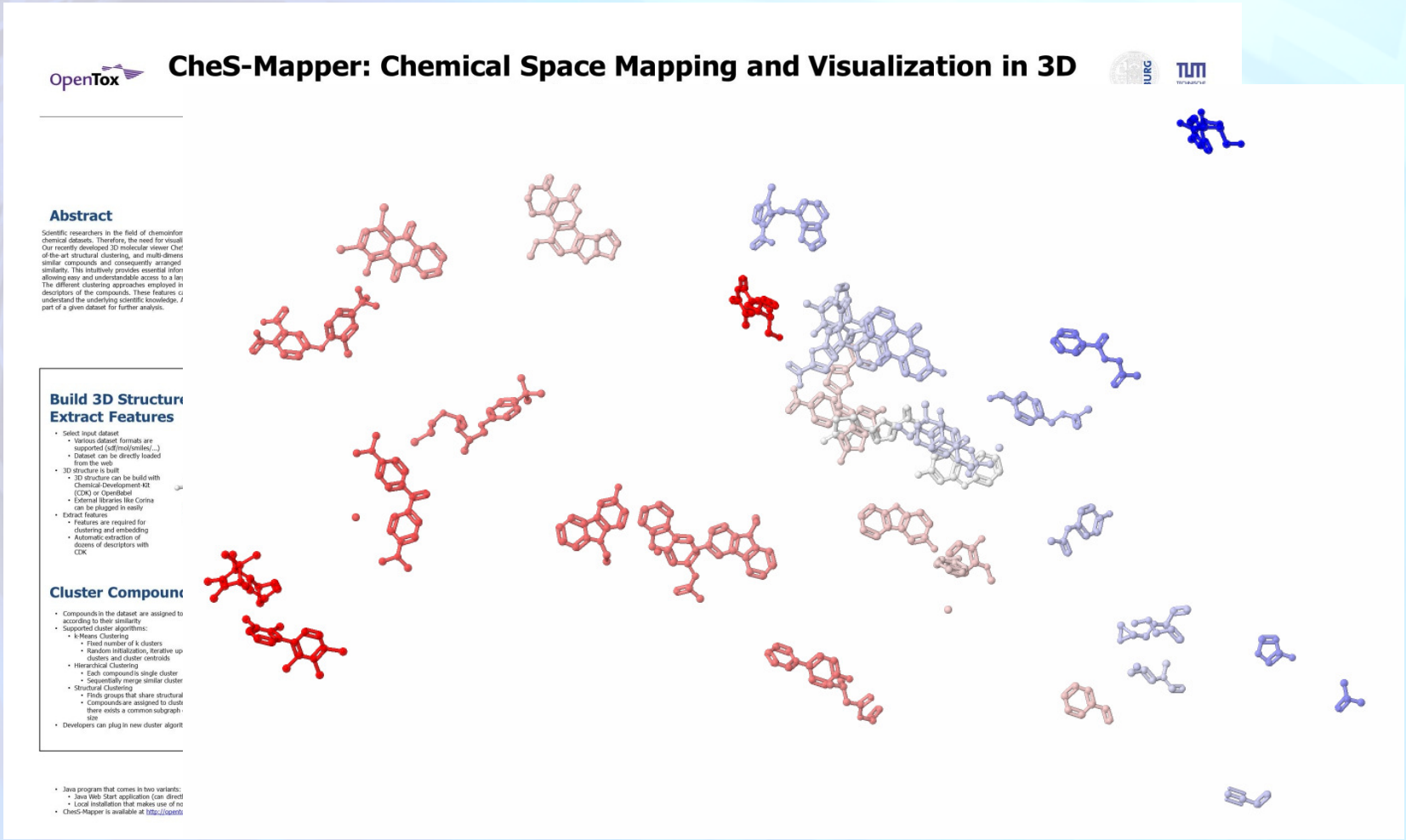
OpenTox

SEVENTH FRAMEWORK PROGRAMME

Chemical Space Visualisation (Ches-Mapper)



Forming chemical feature-based categories

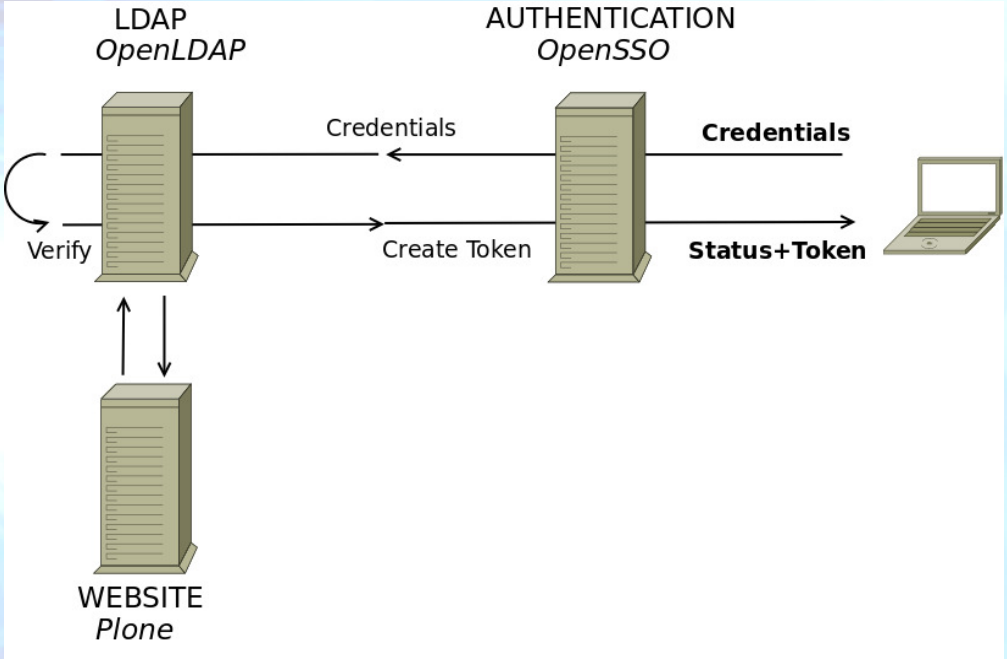


OpenTox

Controlling Access to Confidential Information

- OpenTox makes resources available through URIs
- OpenTox provides facilities to protect confidential information located at URIs. Two tasks are involved here:
  - Authentication: Confirming the identity of the user requesting access
  - Authorisation: Granting the confirmed identity access according to a set of restrictions described in policies

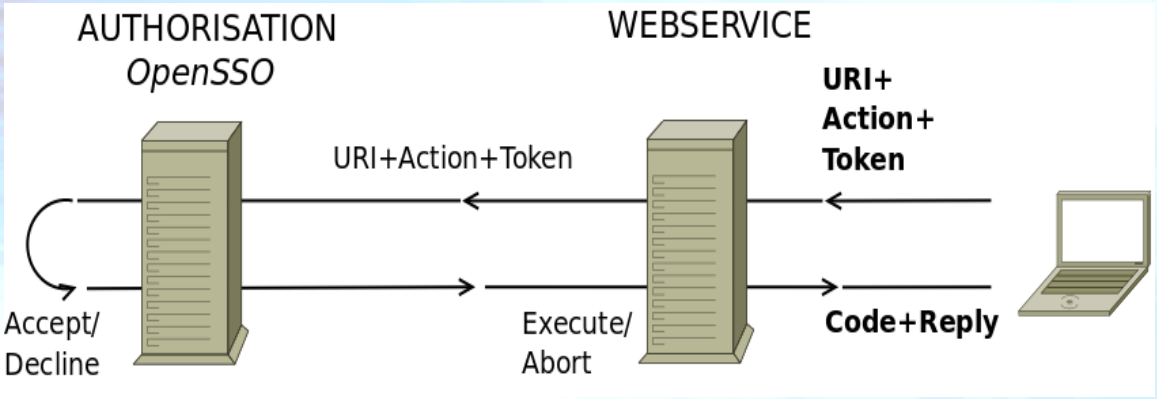
Authentication



- Registered users are instantly available as potential users of OpenTox web services
- Users receive a token upon service request

OpenTox

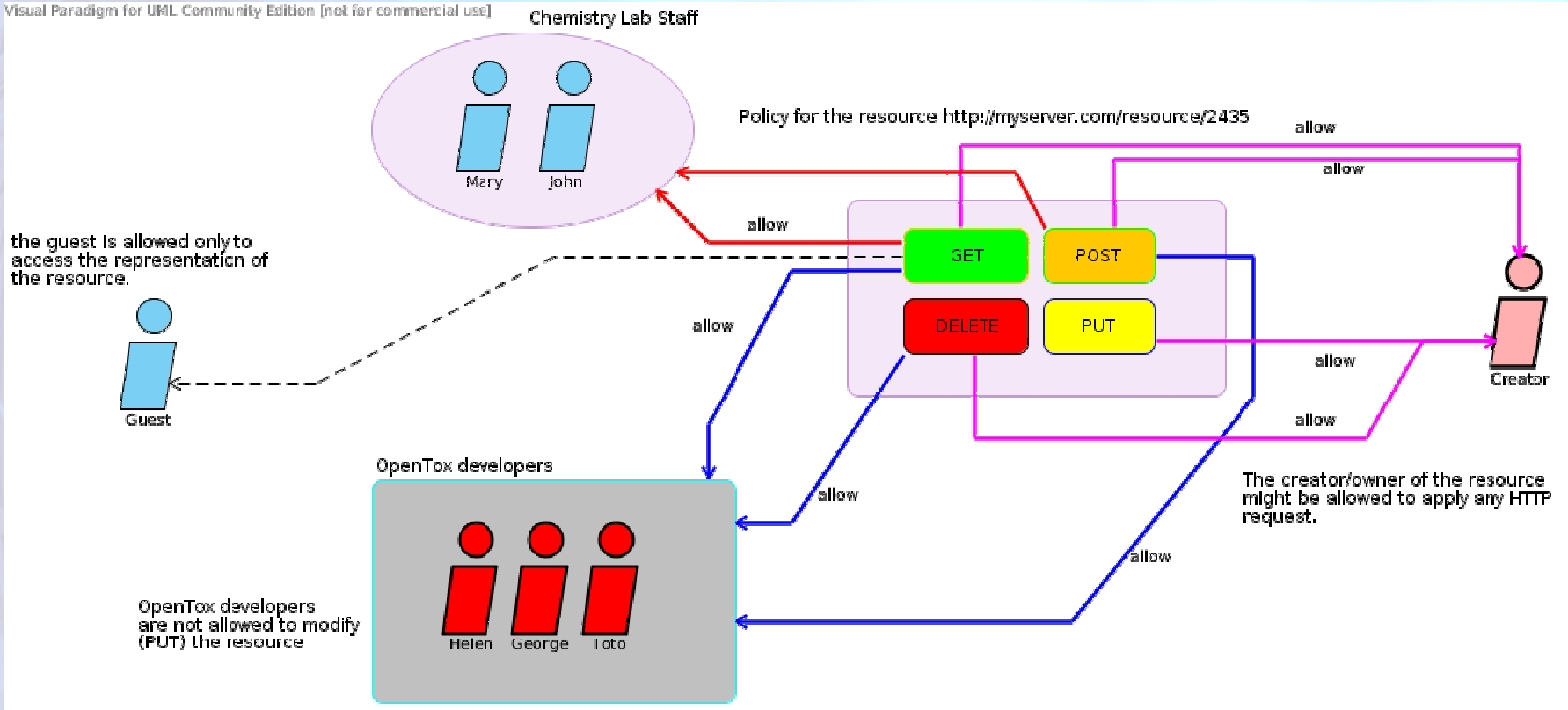
Authorisation



- Tokens encode user identity
- Tokens are valid for a certain time period only (customizable)
- The triplet URI+Action+Token makes up the call to be authorised
- All messages are encrypted (SSL)
- Resource Owners create and modify policies defining access rules

OpenTox

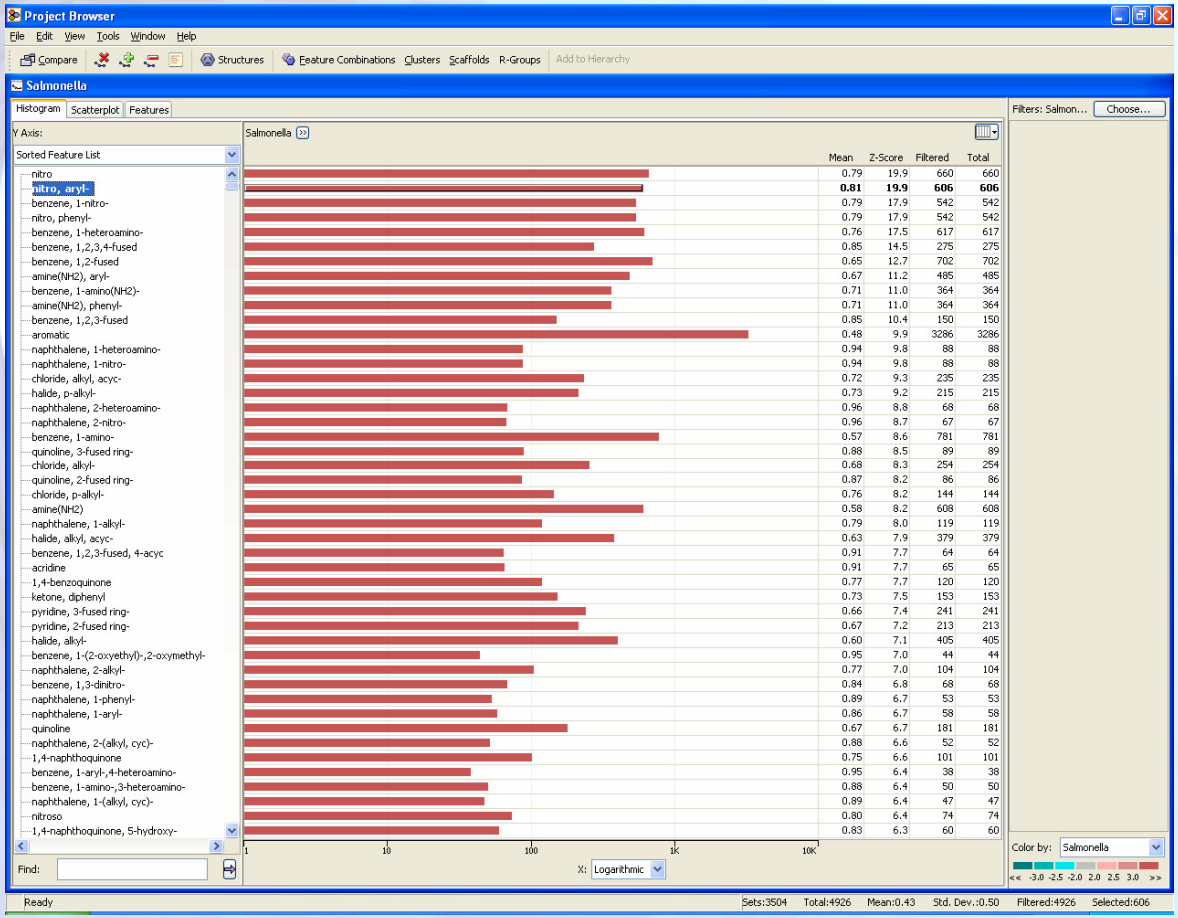
Policies

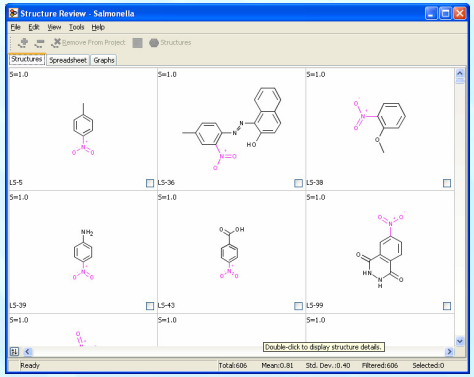


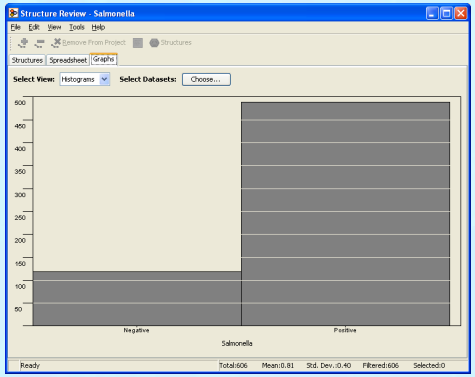
Validation against Confidential Data Case implemented Spring 2011

OpenTox

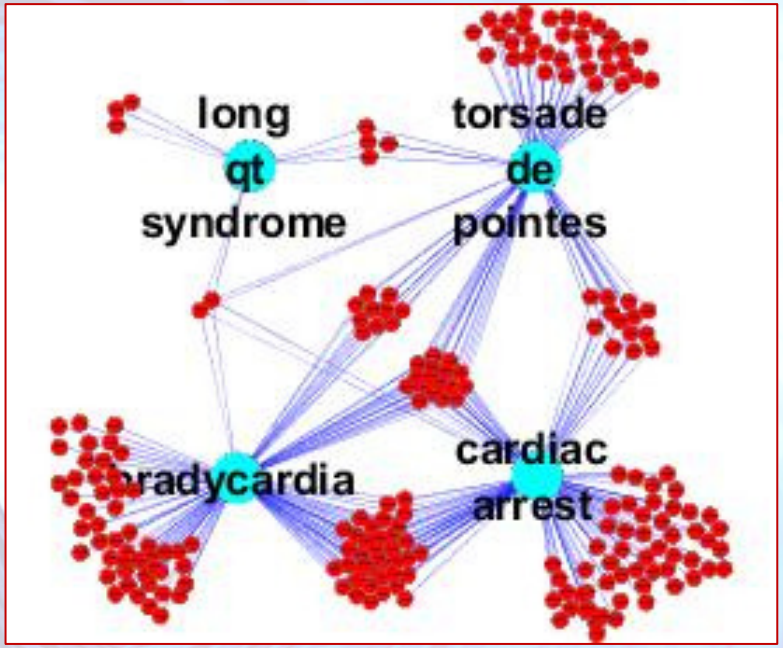
OpenTox - Leadscope Integration







Analysis of Adverse Events Based on Pharmacological Activity



- Cardiac adverse events
- Related to hERG ion channel?

cyan = adverse event, red = drug
lines define links

- Question addressed:
  - Are the adverse events a function of inhibiting the pharmacological target?
  - Or is the adverse event due to an off-target activity?

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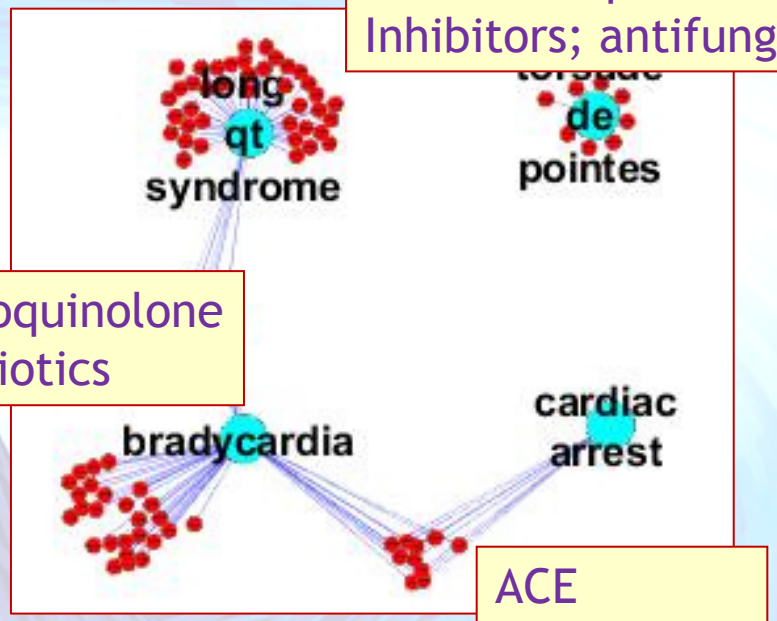
Example: Cardiac Adverse Events



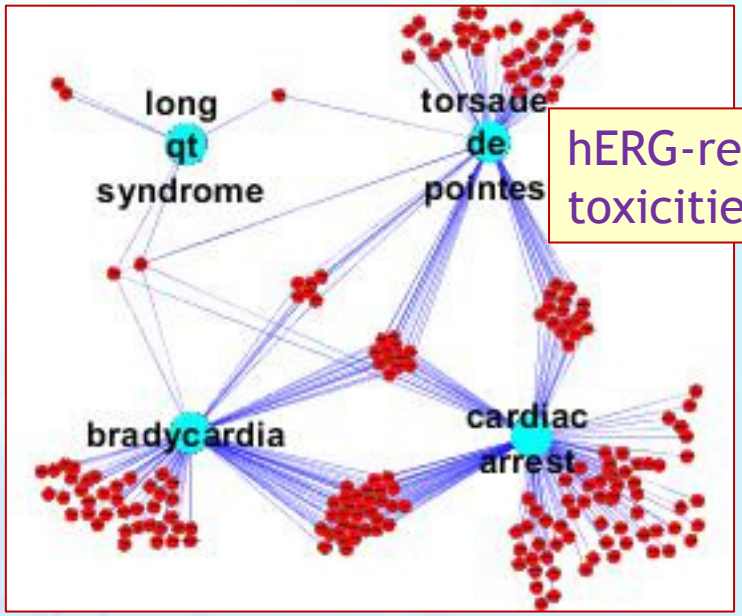
serotonin uptake Inhibitors; antifungals

fluoroquinolone antibiotics

ACE Inhibitors

On-target events

cyan = adverse event, red = drug
lines define links



hERG-related toxicities?

Off-target events

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REACH and Weight of Evidence

Within the REACH legislation, the so-called Weight of Evidence (WoE) approach is a component of the decision-making procedure on substance properties and thus an important part of the chemical safety assessment. In the legal text the use of weight of evidence approach is provided for in Annex XI as an option to meet the information requirements of Annexes VII to X.

According to the ECHA Guidance B the weight of evidence (WoE) approach is not yet a scientifically well-defined term or an agreed formalised concept. It involves assessing the relevance, reliability and adequacy of each piece of available information, holding the various pieces of information up against each other and reaching a conclusion on the hazard. This process always involves expert judgement. It is important to document and communicate how the evidence-based approach was used in a reliable, robust and transparent manner.

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REACH and Weight of Evidence

The ECHA Practical Guide 2 “How to report weight of evidence” (ECHA PG2) defines WoE as an evidence based approach involves an assessment of the relative values/weights of different pieces of the available information that have been retrieved and gathered in previous steps. To this end, a value needs to be assigned to each piece of information. These weights/values can be assigned either in an *objective* way by using a formalized procedure or by using expert judgement. The weight given to the available evidence will be influenced by factors such as the quality of the data, consistency of results, nature and severity of effects, relevance of the information for the given regulatory endpoint. One definition for weight of evidence is: ‘the process of considering the strengths and weaknesses of various pieces of information in reaching and supporting a conclusion concerning a property of the substance.’

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REACH and Weight of Evidence

Within Weight of evidence is closely linked to *integrated testing/information strategies (ITS)*, in that the available evidence can help to determine the possible subsequent testing steps.
The WoE approach may be applied if there is sufficient information from **several independent sources** leading to the conclusion that a substance does or does not have a particular dangerous property, while the information from each single source alone is regarded insufficient to support this notion (ECHA Evaluation 2010).
If any of the Annex XI conditions for (Q)SAR for waiver are not met, the **(Q)SAR results cannot be used instead of testing but they may be used as a part of a Weight of Evidence approach**.
When data from a single secondary source is used, it is essential to provide further supporting evidence e.g. QSAR predictions, manufacturing data, data taken from material safety data sheets, etc.
All relevant information for the hazard endpoint should be addressed and a justified weight should be assigned to it in the overall assessment. (ECHA Evaluation 2010)

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Proposed Paper (s): Satisfying REACH Alternative Testing Information Requirements

1 Supporting Information Gathering & Evaluation

2 Data Sourcing and Integration

3 (Q)SARS (including Applicability Domain, Validation, QMRF, QPRF reporting, Reliability, Confidence)

4 Categories and Read Across

5 Weight of Evidence (REACH and WoE could be a focus paper itself)

6 Predicting Metabolites

7 Achieving Harmonisation through Ontologies

Preparation Timeframe Sept-Nov 2011.

Interested in Collaborating on this paper?

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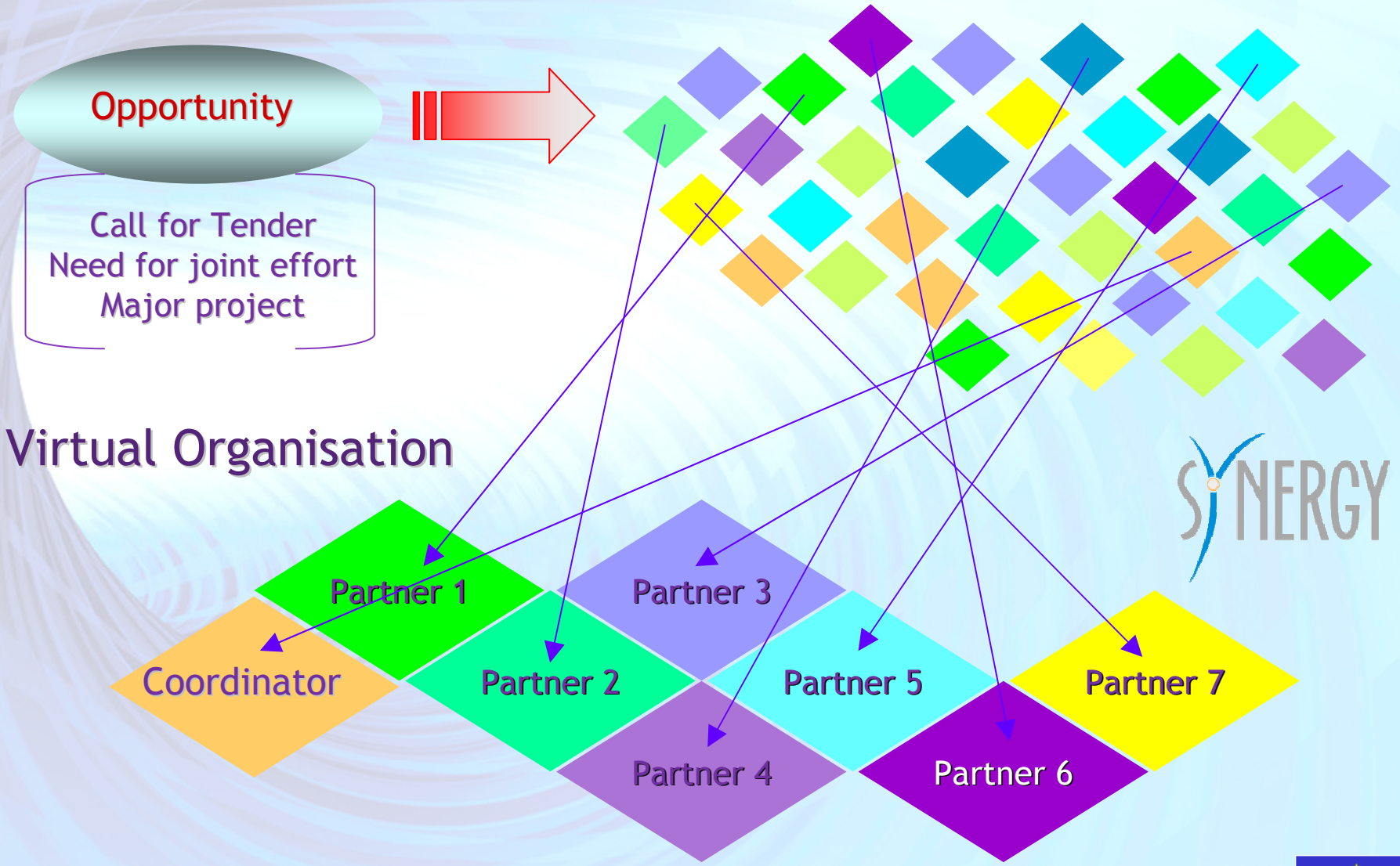
Creation of VO from Collaboration Pool



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www.synergy-ist.eu

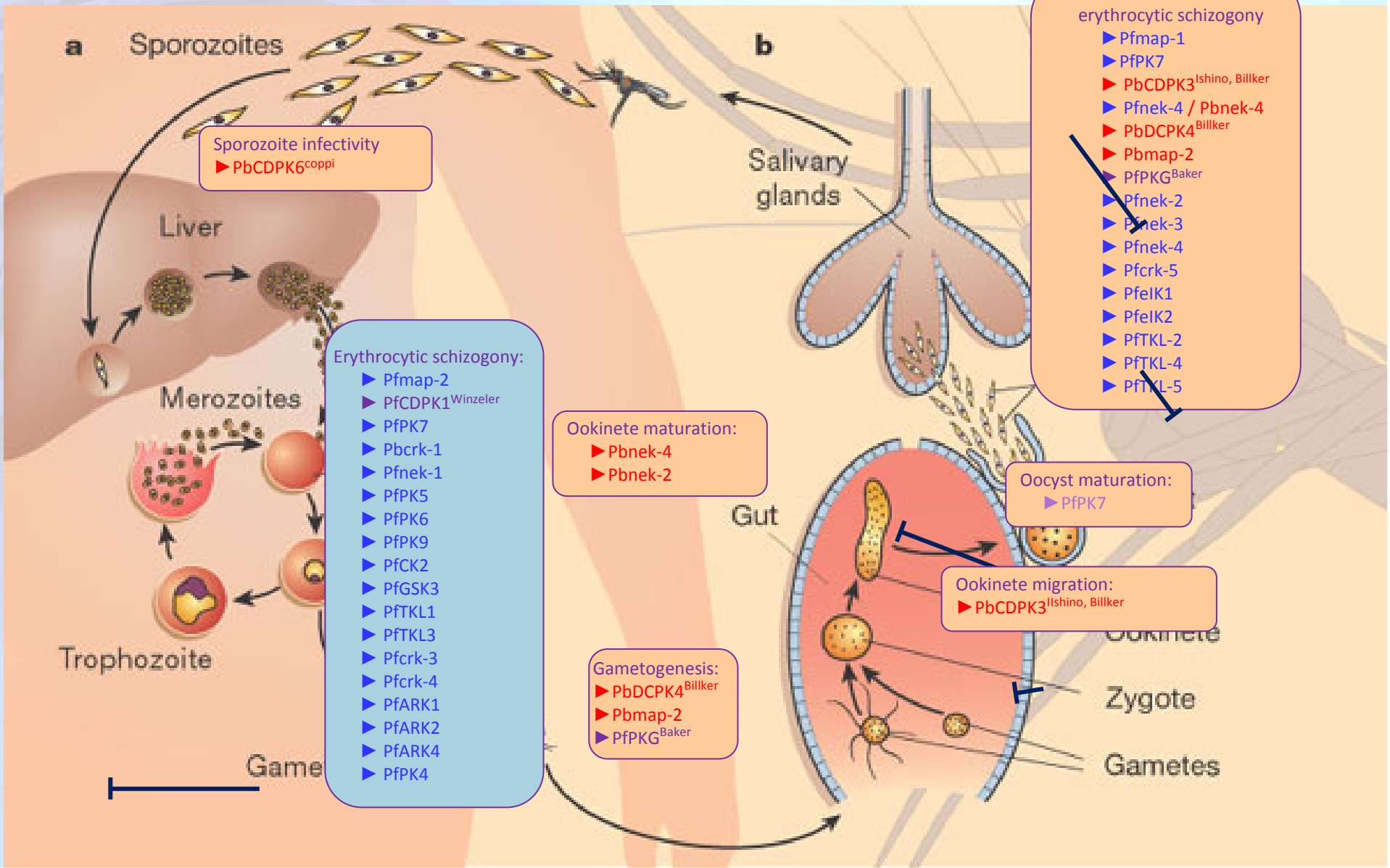
Initial Experience on SAM VO

Scientists Against Malaria (Pilot initiated June 2010)

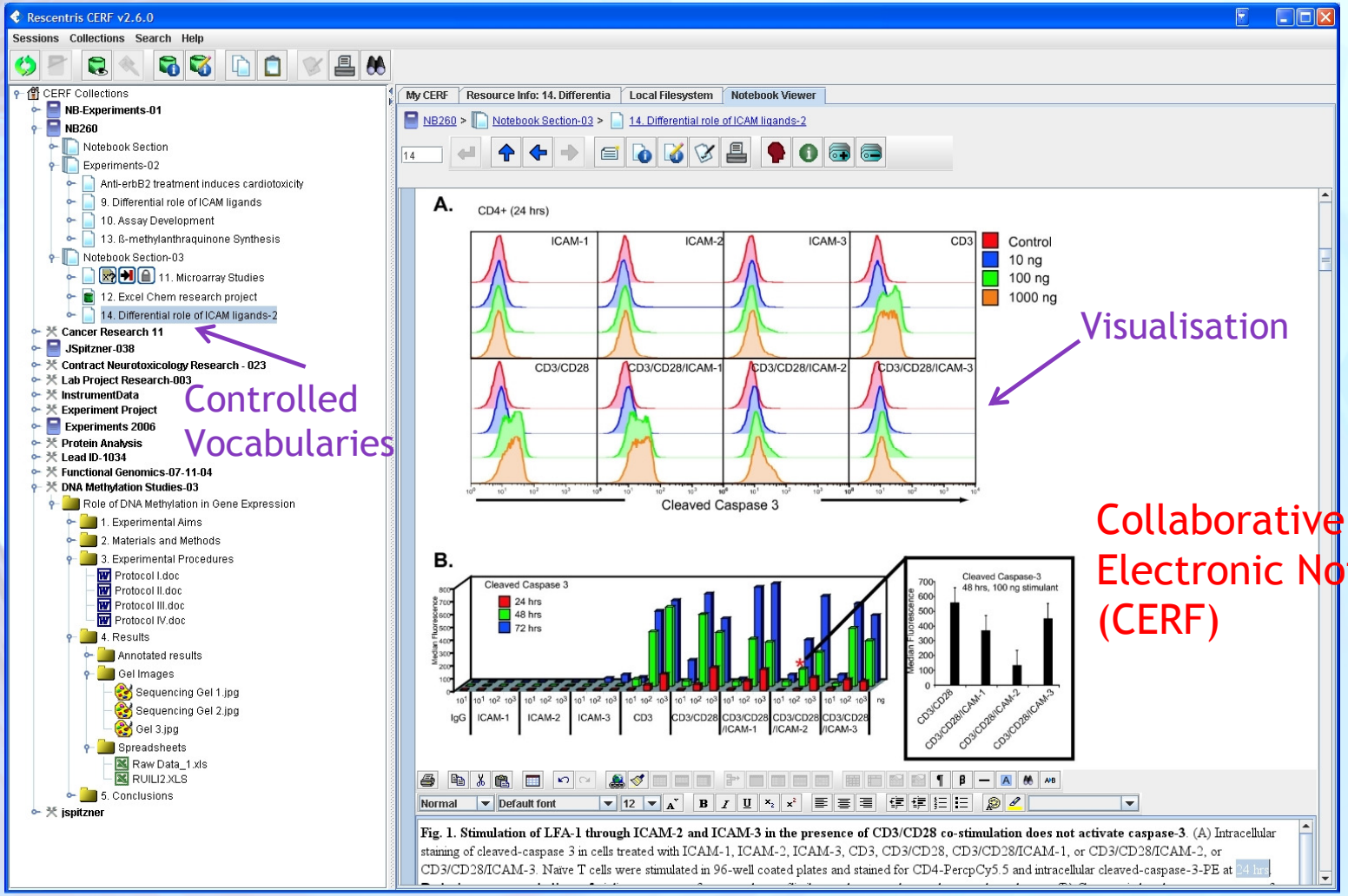
Using a low budget approach, strong interdisciplinary collaboration and innovative infrastructure and modelling developments, we moved a green field drug discovery project on a novel parasitic kinase target with no initial solved structure or known ligand at the start of the Pilot Project to Dose Response characterised leads within 9 months.

We are now extending chemical and kinome space exploration of activity relationships and developing schemes for toxicity profiling and prioritisation of compound libraries.

SAM Virtual Organisation targeting Plasmodium Kinases (www.ScientistsAgainstMalaria.net)



Collaborative Research Framework Integration



Controlled Vocabularies

Visualisation

Collaborative Electronic Notebook (CERF)

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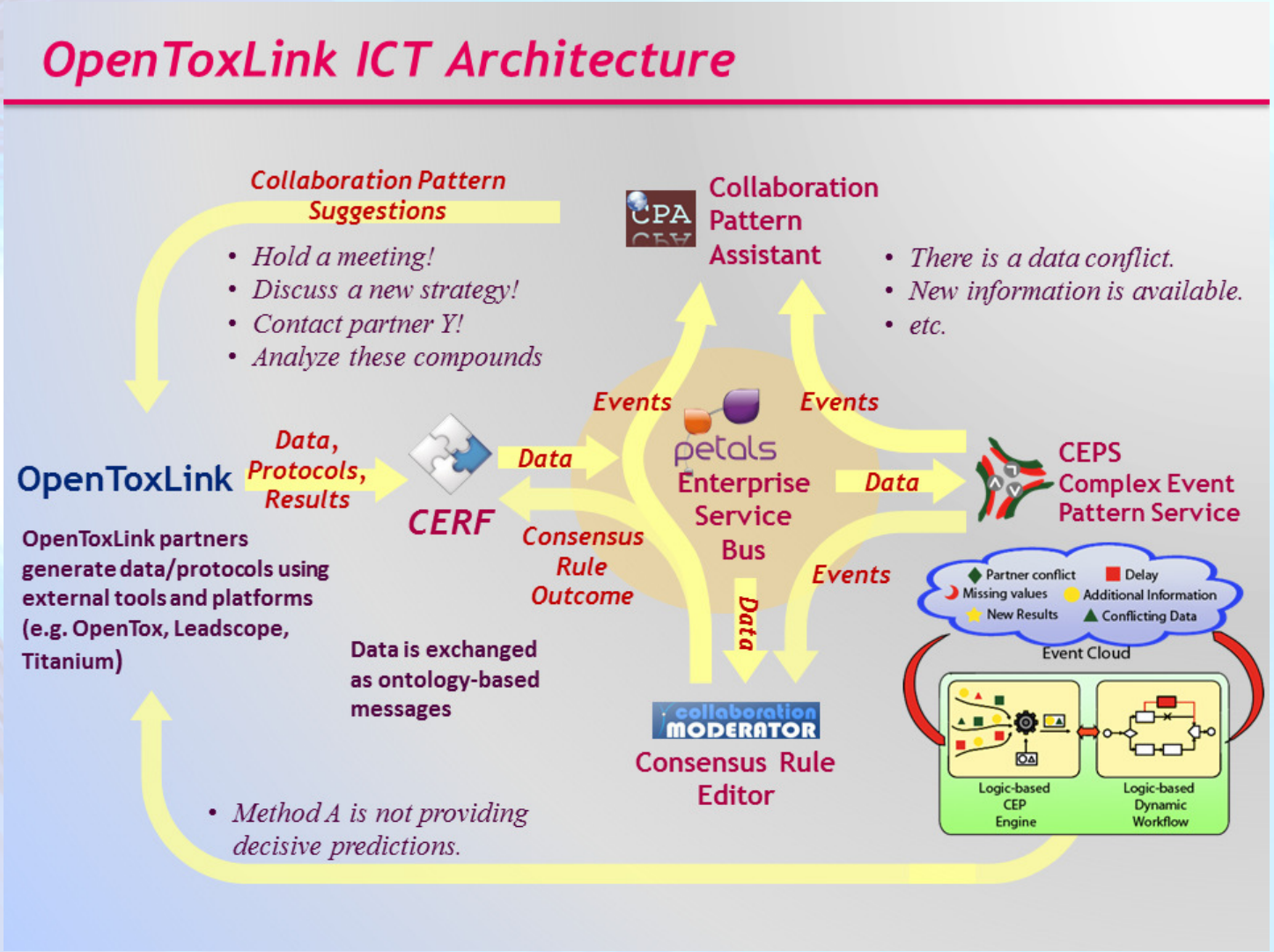
Event Driven Collaboration Architecture



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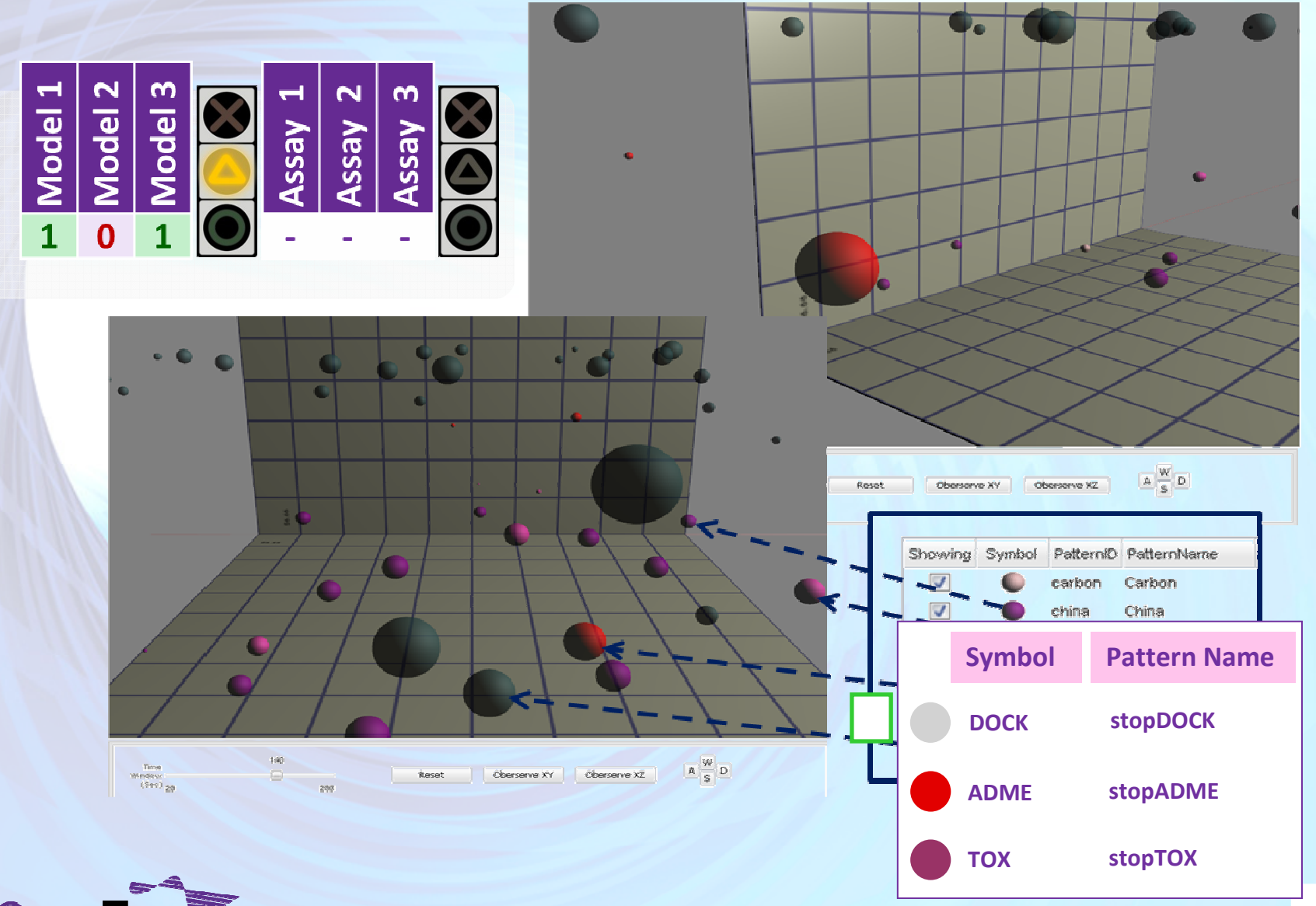
Processing Complex Events Stream



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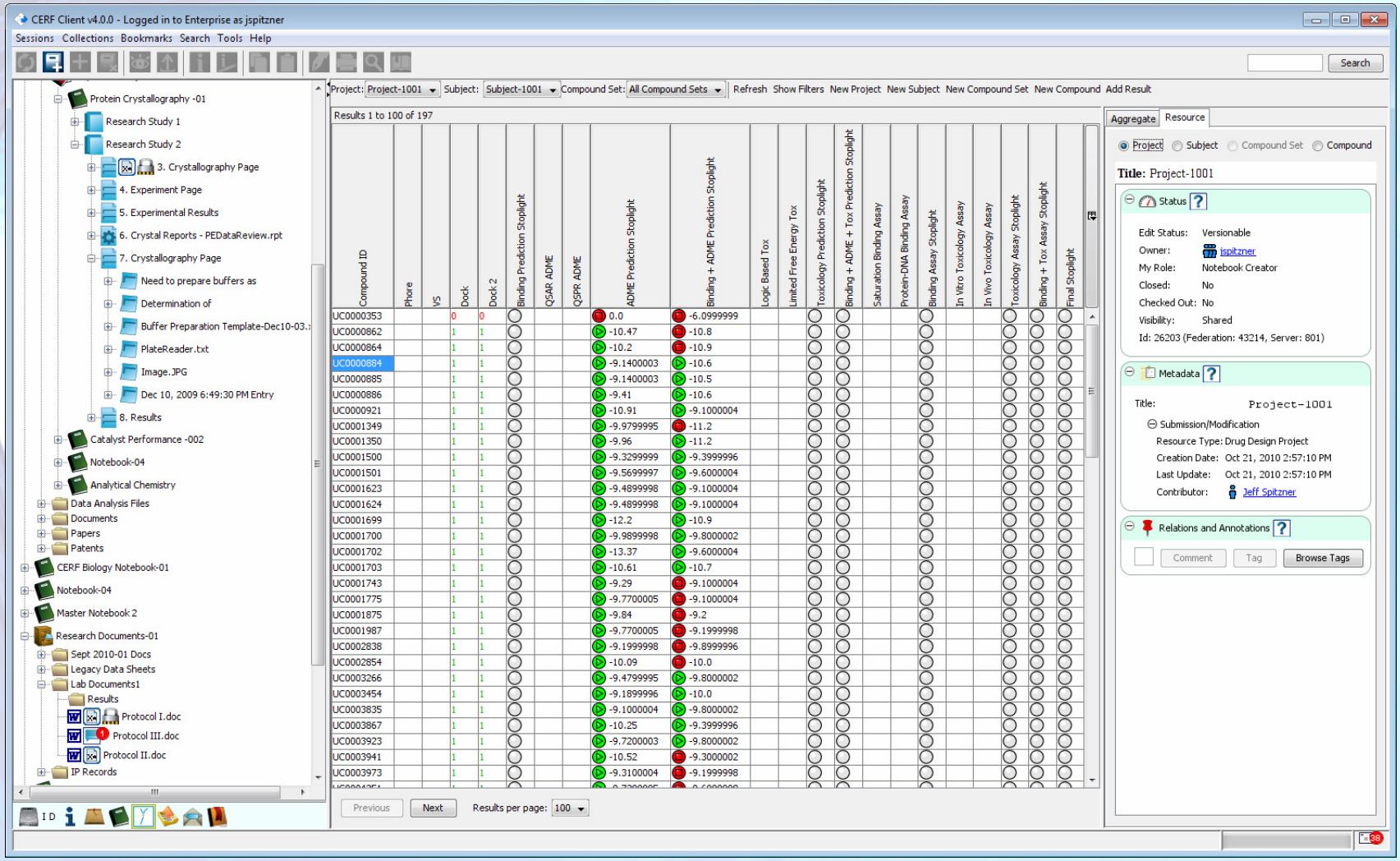
Event Driven Weight of Evidence



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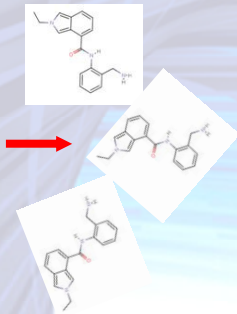
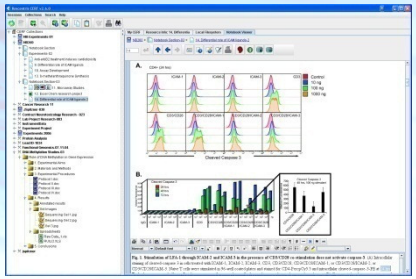
Synergy Drug Design Collaboration Pilot

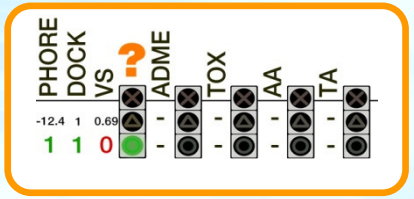


Screened Library

Data



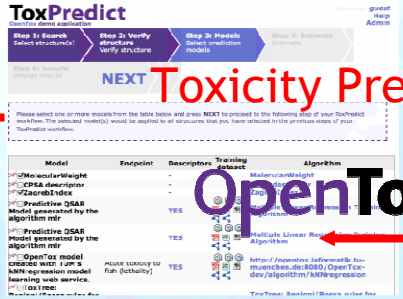
CERF



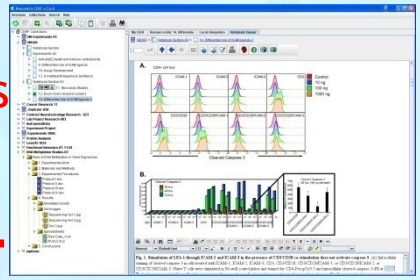
Refine Predictions

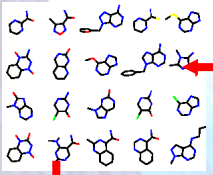
SYNERGY

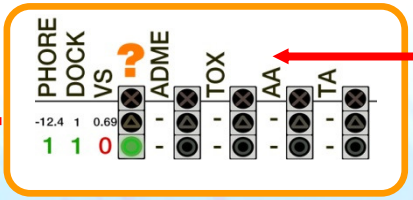
Data



Toxicity Predictions

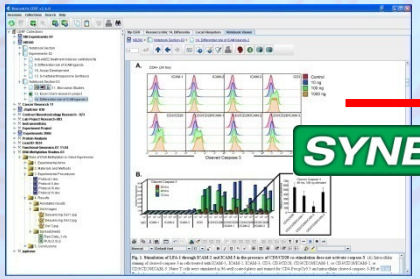




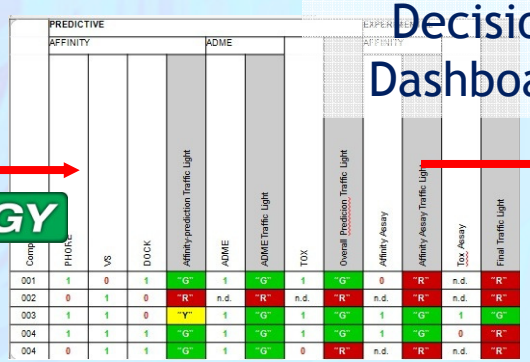


SYNERGY

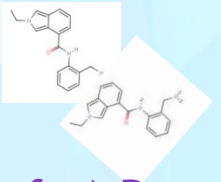
Toxicity Assays



SYNERGY



Decision Dashboard



(Safer) Drug Leads

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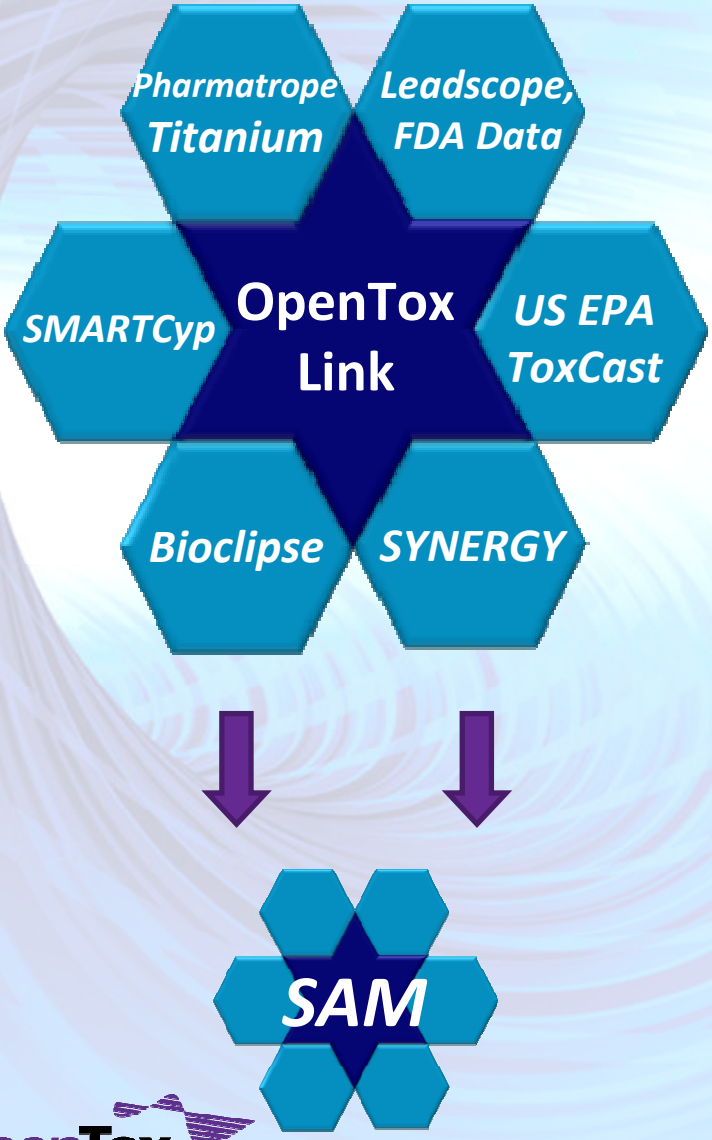
www.scientistsagainstmalaria.net

The OpenToxLink Virtual Organisation



1. Data Mining of Human Adverse Drug Events
   - Data Mining of Literature Knowledge
2. Creation of Mechanism-based Hypothesis
   - Selection of Biological Pathways & Targets
3. Selection of Compounds
   - Prediction of Metabolites of Compounds
4. Selection of *in vitro* assays relevant to Mechanism
   - Selection and integration of Toxicity Data
5. Creation of Predictive Toxicology Model including Model Validation and Applicability Domain
6. Selection of Low and High Content Assays for Testing in Cell Lines
   - Analysis of Results

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Weight of Evidence driven Prioritisation

A Weight-of-Evidence Approach to Prioritisation based on Consensus across Multiple Sources of Information

Roman Affentranger and Barry Hardy, Douglas Connect, Switzerland
Glenn Myatt, Leadscope, USA
Nina Jeliazkova, IdeaConsult, Bulgaria
Matthew Clark and Jeff Wiseman, Pharmatrope, USA

We present the results of initial work carried out within the OpenToxLink Virtual Organization, applying a Weight-of-Evidence (WoE) approach based on consensus across multiple sources of information for the prediction of adverse effects of a large set of potential antimalarial compounds. The work was carried out as part of the EU FP7 project SYNERGY, evaluating the support of decision dashboards and event-driven collaborative research of software developed within SYNERGY. **...**

Poster presented at OpenTox 2011, Munich

www.opentox.org/meet/opentox2011/posters/a-weight-of-evidence-approach-to-prioritisation-based-on-consensus-across-multiple-sources-of-information

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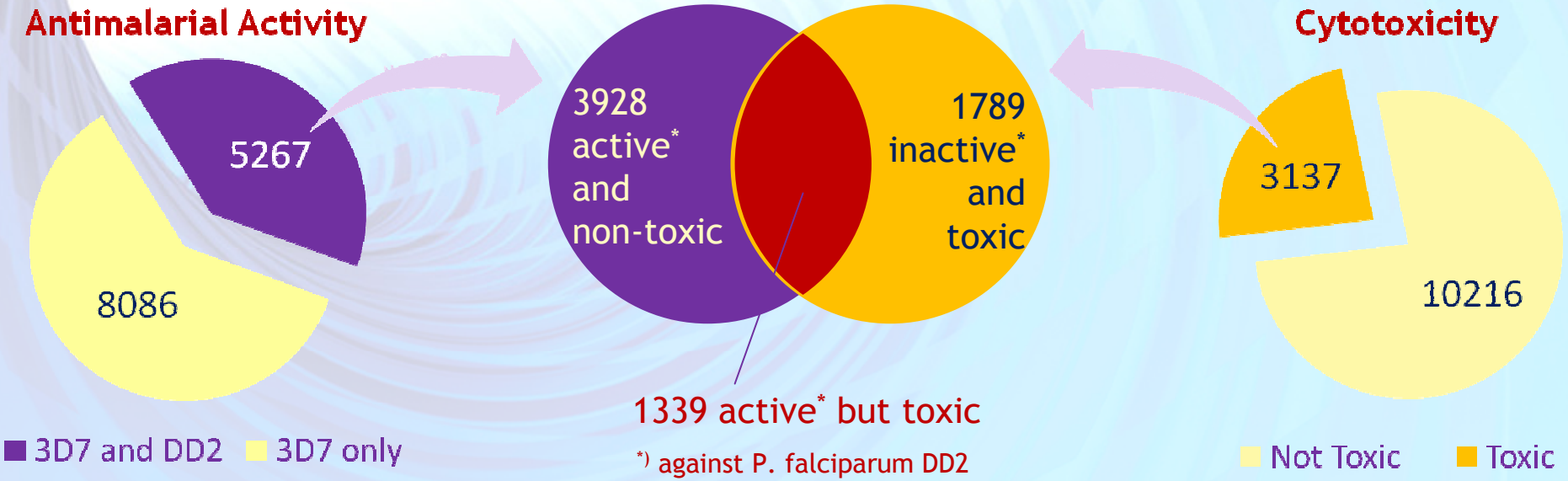
The TCAMS MalariaBox

"Malaria Box": A collection of chemical compounds active against (i.e. inhibiting growth of) the malaria parasite Plasmodium falciparum

Data provided that is relevant for this project:

- Activity against (growth inhibition of) P. falciparum strain 3D7 (common strain)
- Activity against (growth inhibition of) P. falciparum strain DD2 (multi-drug resistant strain)
- Cytotoxicity against (growth inhibition of) human hepatocytes, HepG2 (hepatoma cells)



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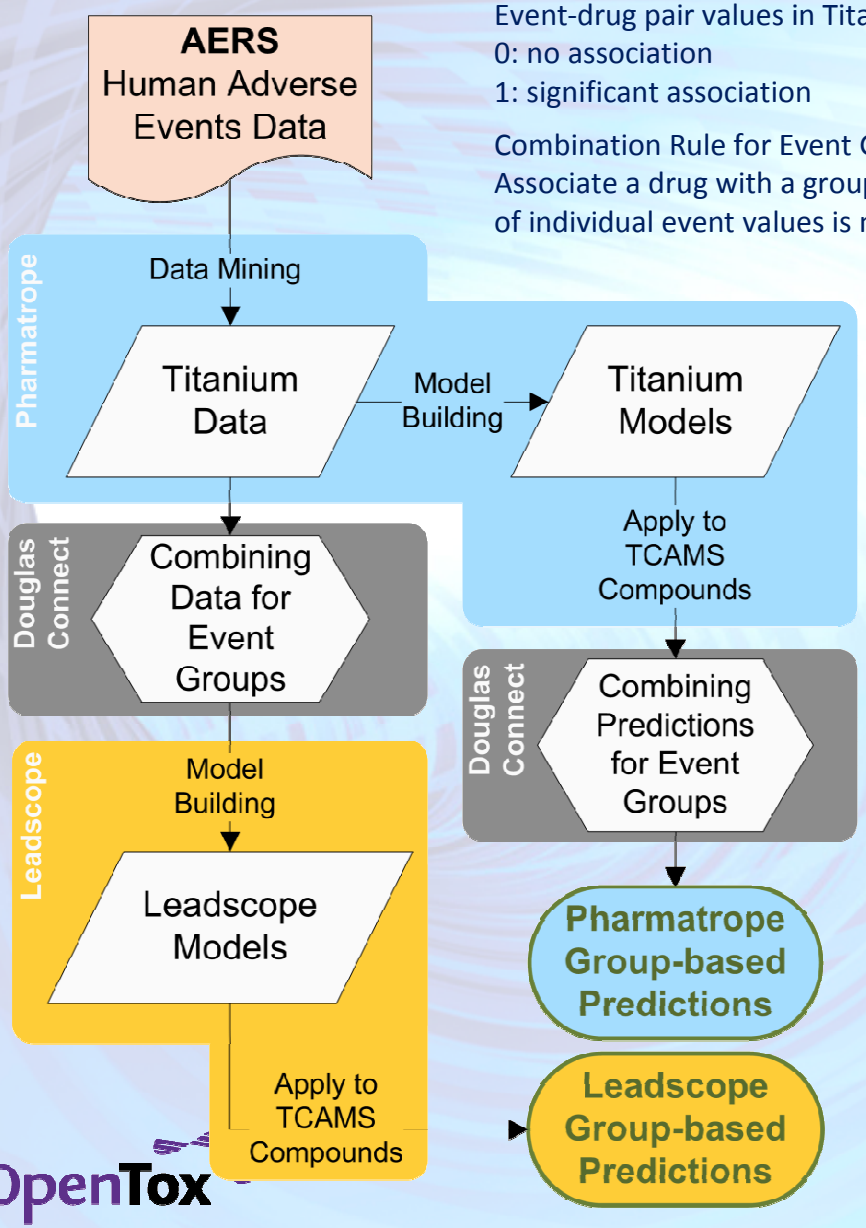
Gamo et al., Nature 465(7296), 305-10 (2010)

Human Adverse Events Data



Event-drug pair values in Titanium Data:
0: no association
1: significant association

Combination Rule for Event Groups:
Associate a drug with a group if the sum of individual event values is non-zero

Event-drug pair values in Titanium Predictions:
0 : no association (0)
0.35-0.4 : non-significant association (0)
> 0.4 : significant association (1)

Combination Rule for Event Groups:
Associate a drug with a group if the sum of individual event values is larger of equal to 0.4.

Adverse Event Groups	Group Name
Hepatic function abnormal Liver disorder	**FuAbn**
Hepatic necrosis	**Nec**
Cytolytic hepatitis Hepatitis Hepatitis acute Hepatitis toxic	**Hepa**
Cholestasis Jaundice Hepatitis cholestatic jaundice cholestatic Yellow skin	**CholJa**
Hepatic failure Hepatitis fulminant Acute hepatic failure Hepatorenal failure	**HepFail**
Hepatotoxicity Hepatomegaly Hyperbilirubinaemia Hepatosplenomegaly	**HepTox**

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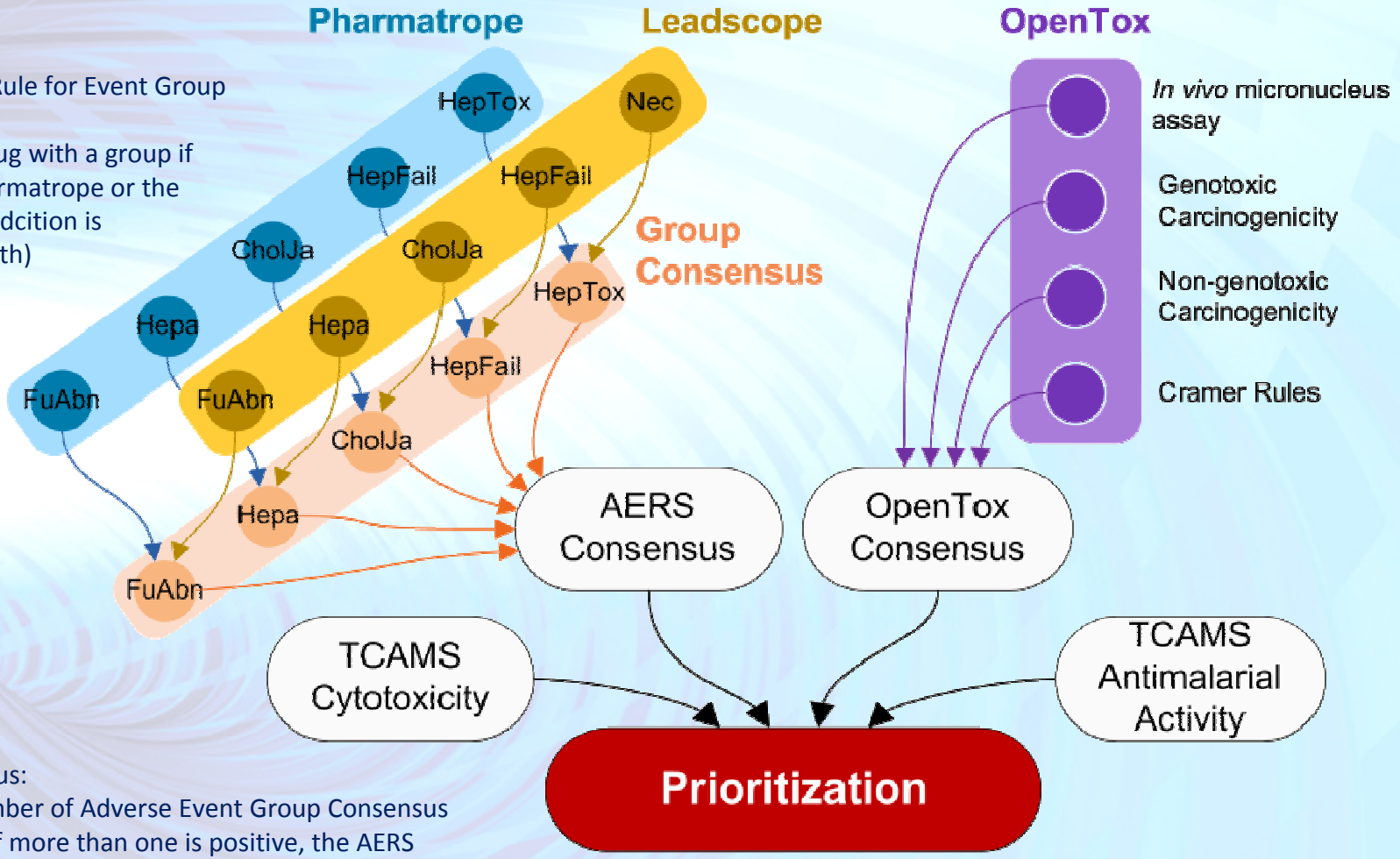
Combining Predictions and Experimental Data

Combination Rule for Event Group Predictions:
Associate a drug with a group if either the Pharmatrope or the Leadscope predcition is positive (or both)



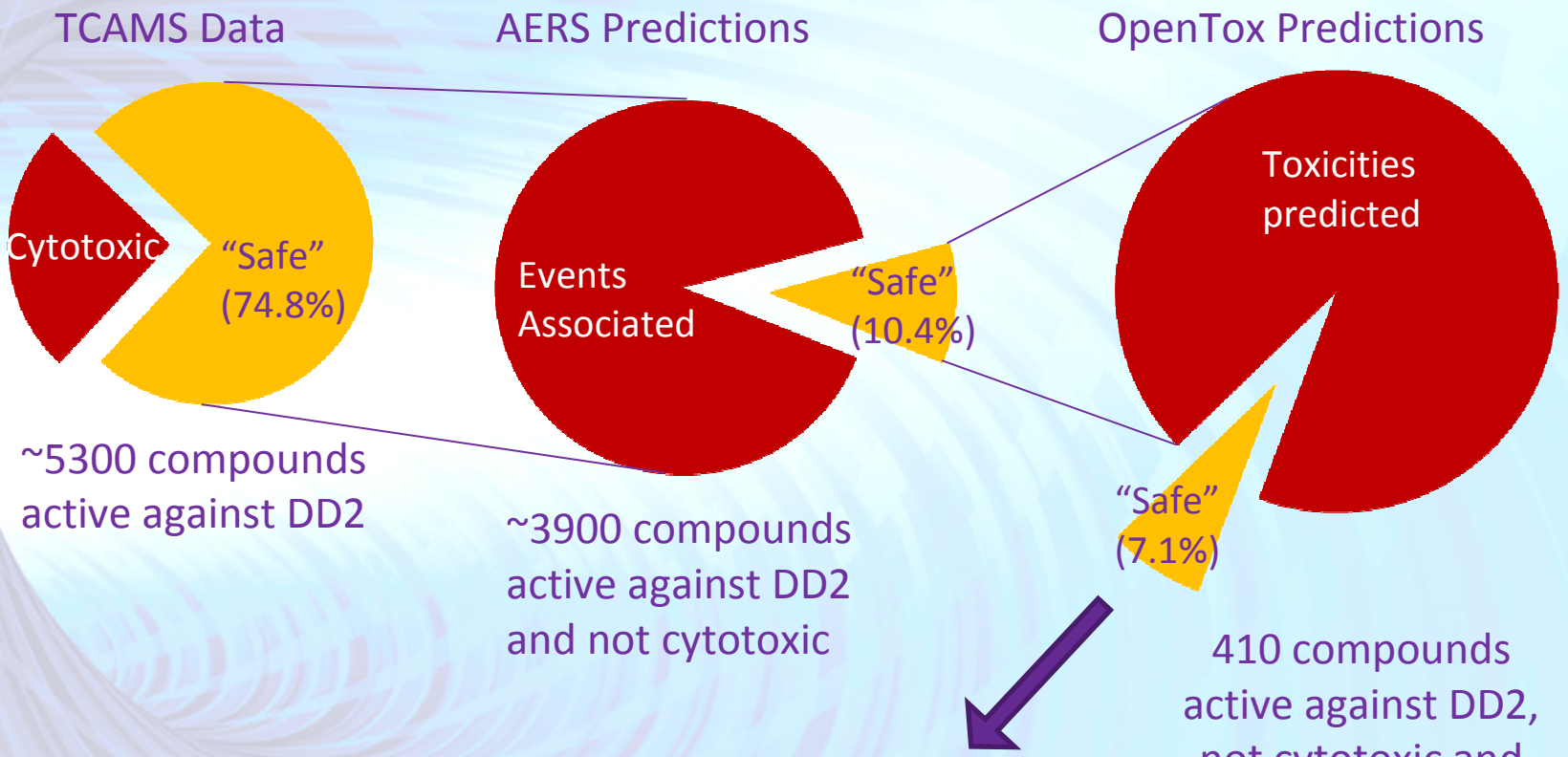
AERS Consensus:
Count the number of Adverse Event Group Consensus associations. If more than one is positive, the AERS Consensus is positive.

OpenTox Consensus:
Negative if both carcinogenicity and the micronucleus assay predictions are negative, OR if the Cramer Rule classification is Class I. Positive otherwise.

TCAMS Cytotoxicity:
Positive if > 30% growth inhibition at 10 µM.

TCAMS Antimalarial Activity:
Positive if > 80% growth inhibition of P. Falciparum DD2 at 2 µM.

Compound Prioritization Results



29 compounds without any indication of adverse events or toxicities

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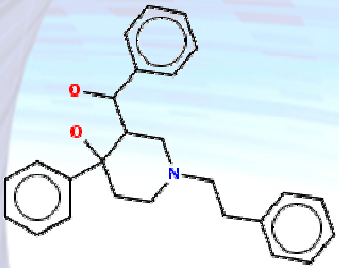
Example compounds

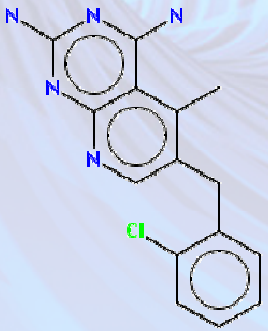
"Safe"



TCMDC-131287:

- No predicted association with adverse events (consistent)
- Negative for carcinogenicity and mutagenicity
- No inhibition of HepG2 growth
- Strong inhibition of P. falciparum DD2 growth

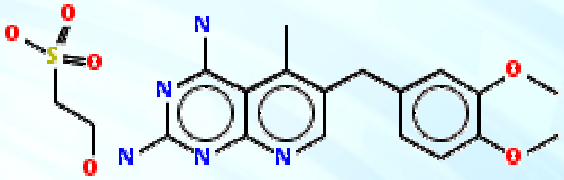
"Toxic"



TCMDC-137245:

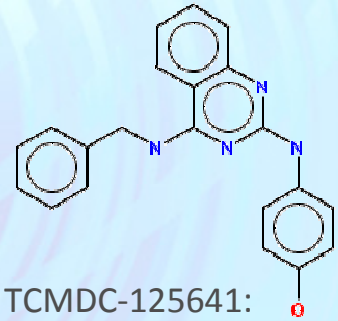
- Associated with 4 and 5 (out of 5) adverse events group by Pharmatrope and Leadscope, respectively
- Positive for carcinogenicity and mutagenicity, Cramer Class III
- 67% HepG2 inhibition (10 µM)
- 91% P. falciparum DD2 growth inhibition (at 2 µM)

Ambiguous, Further Data Required



TCMDC-138057:

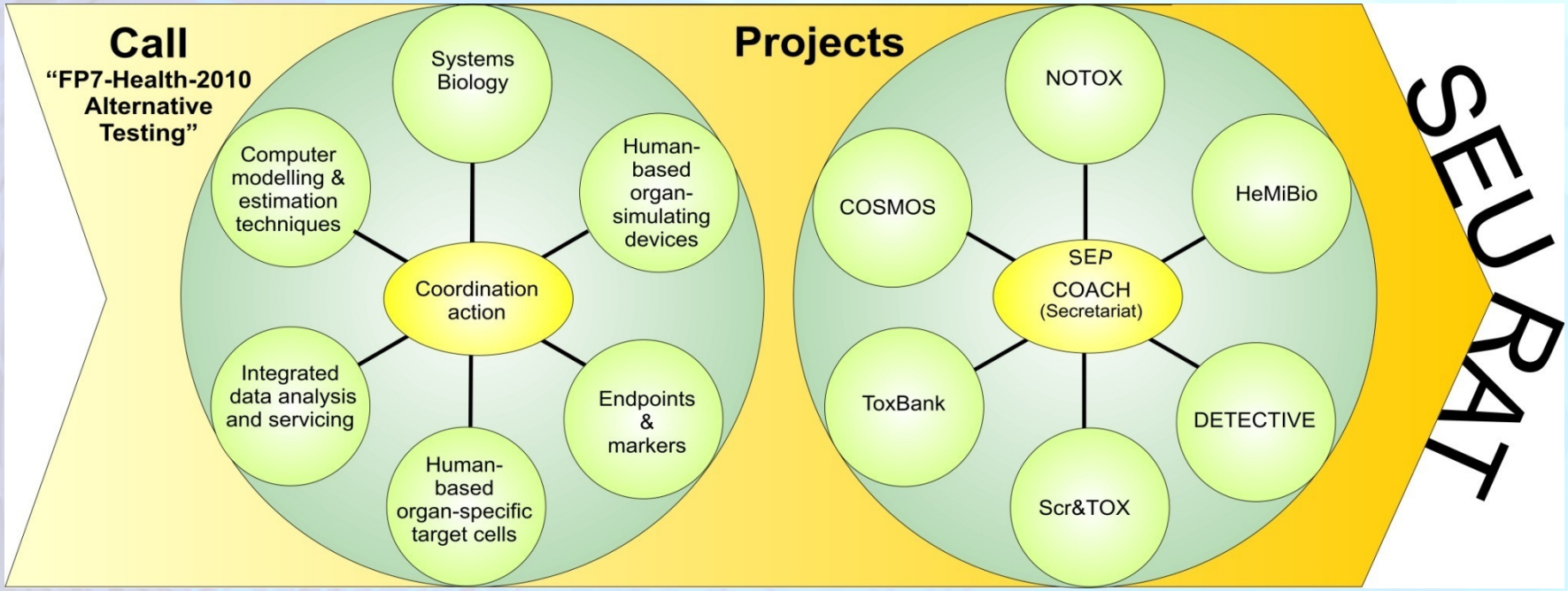
-Predicted association with many adverse events groups
-Positive for carcinogenicity and mutagenicity
-Considered safe (Class I) with Cramer rules
-Inhibition of HepG2 growth could not be measured
-Strong inhibition of P. falciparum DD2 growth



TCMDC-125641:

-No adverse event association predicted with Pharmatrope models
-Strong association with all five adverse events groups predicted with the Leadscope models
-Negative for carcinogenicity and mutagenicity
-Intermediate inhibition of HepG2 growth (33% at 10 µM)
-Strong inhibition of P. falciparum DD2 growth (100% at 2 µM)

The Building Blocks of SEURAT-1



~ 70 research groups from European Universities, Public Research Institutes and Companies (more than 30% SMEs)

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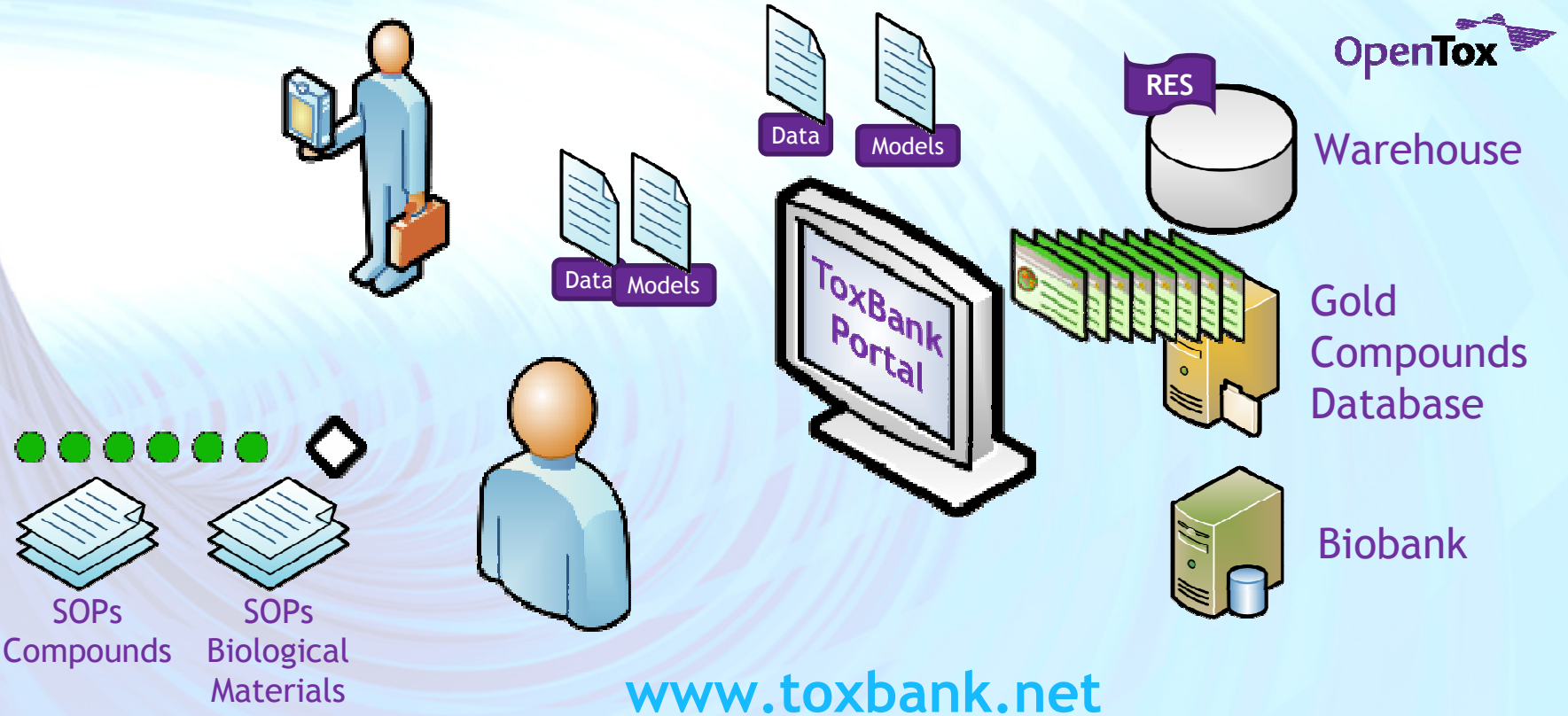
The Building Blocks of SEURAT-1

- Stem cell differentiation for providing human-based organ specific target cells
- Development of a hepatic microfluidic bioreactor
- Identification and investigation of human biomarkers
- Delivery of computational tools to predict the effects of chemicals based on *in silico* calculations and estimation techniques
- Development of systems biological tools for organotypic human cell cultures
- Supporting integrated data analysis and servicing of alternative testing methods in toxicology
- Cluster level Coordinating and Support Action

Our Infrastructure Vision for ToxBank supporting all steps of Predictive Toxicology Research based on Alternative Testing methods

Users access compounds, biological materials, data and models for experimental planning and integrated analysis of experimental results



www.toxbank.net

This project will be jointly funded by COLIPA and the EC. Any opinions expressed in this slide are those of the author. COLIPA is not liable for any use that may be made of the information contained therein.

OpenTox InterAction Meeting 2011

Innovation in Predictive Toxicology

Modeling, Applications, REACH, Risk Assessment

9-12 August, 2011
Technical University of Munich, Germany

Ca. 80 attendees participated in workshop, knowledge cafés, conference, poster session

More Information at:
www.opentox.org/meet/opentox2011

There will be an OpenTox 2012!

Collaborating Partners

Douglas Connect, Switzerland (Coordinator)

In Silico Toxicology, Switzerland

Albert Ludwigs University Freiburg, Germany

Ideaconsult, Bulgaria

National Technical University of Athens, Greece

Istituto Superiore di Sanità, Italy

Fraunhofer Institute for Toxicology & Experimental Medicine, Germany

Technical University of Munich, Germany

David Gallagher, UK

Institute of Biomedical Chemistry of the Russian Academy of Medical Sciences, Russia

Seascape Learning & JNU, India

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Our Funding Support...

OpenTox - An Open Source Predictive Toxicology Framework, www.opentox.org, is funded under the EU Seventh Framework Program: HEALTH-2007-1.3-3 Promotion, development, validation, acceptance and implementation of QSARs (Quantitative Structure-Activity Relationships) for toxicology
Project Reference Number Health-F5-2008-200787 (2008-2011).

For more information, visit
www.opentox.org

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