



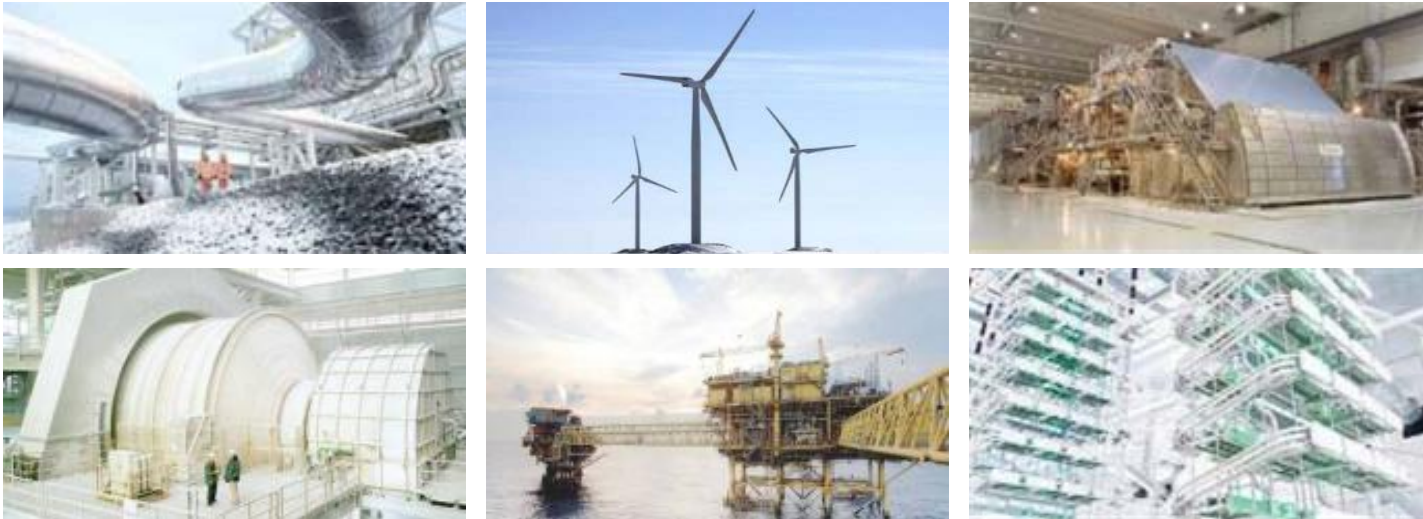
Christoph Winterhalter, Leiter ABB Forschungszentrum Ladenburg

Let's talk AutomationML

Die letzte Lücke wird geschlossen

Power and productivity for a better world

ABB's vision



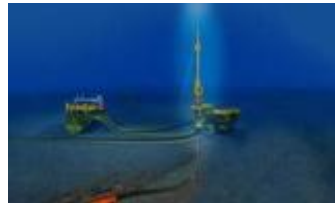
As one of the world's leading engineering companies, we help our customers to use electrical power efficiently, to increase industrial productivity and to lower environmental impact in a sustainable way.

Power and automation are all around us

You will find ABB technology...



orbiting the earth and working beneath it,



crossing oceans and on the sea bed,



in the fields that grow our crops and packing the food we eat,



on the trains we ride and in the facilities that process our water,



in the plants that generate our power and in our homes, offices and factories

Research & Development at ABB

Innovation is key to ABB's competitive advantage

Leadership built on consistent R&D investment

* Comprises non-order related R&D and order-related development



- More than 1.3 BUSD invested annually in R&D*
- 7500 scientists and engineers
- Collaboration with 70 universities
MIT (USA), Tsinghua University (China), KTH Royal Institute of Technology (Sweden), IIT Indian Institute of Science (India), ETH Zürich (Switzerland), KIT Karlsruhe Institute of Technology (Germany), AGH University of Science and Technology (Poland)

ABB Research locations



ABB Corporate Research Center Germany

- 110 scientists and 25 students
- 50 invention disclosures and 100 publications per year

Corporate Research Center Ladenburg

Strategic Focus Areas

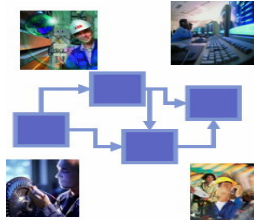


Plant Automation

Next Generation **architectures and engineering methods** for process and batch automation systems from field to plant level

Factory Automation

New **technologies and engineering methods** for efficient integration of key components in discrete automation applications



Service Solutions

Inventing and driving industrial service automation with **technologies, processes and business models**

Building Automation

Home and building automation enabling energy efficiency, ambient assisted living, E-mobility and grid integration



Power Device Mechatronics

New **actuator and sensor solutions** on device level for efficient and reliable transmission and distribution of electricity



AutomationML

The importance of data exchange across tools for ABB Engineering efficiency as key differentiator



- Engineering in Automation and Power technology
 - Process Automation
 - Factory Automation
 - Power Generation
- Annual engineering cost of several BUSD
 - Engineering only partly based on ABB engineering tools
 - Permanently dealing with heterogeneous tool landscapes
- The integration of engineering tools, that don't know each other is still an unsolved problem

AutomationML

More than just geometry data



- Today the AutomationML format provides
 - Standardized geometry and kinematics based on COLLADA
 - Standardized discrete Logic based on PLCOpen XML
 - Standardized object models based on CAEX
- AutomationML can already today cover much more than most people know.



AutomationML

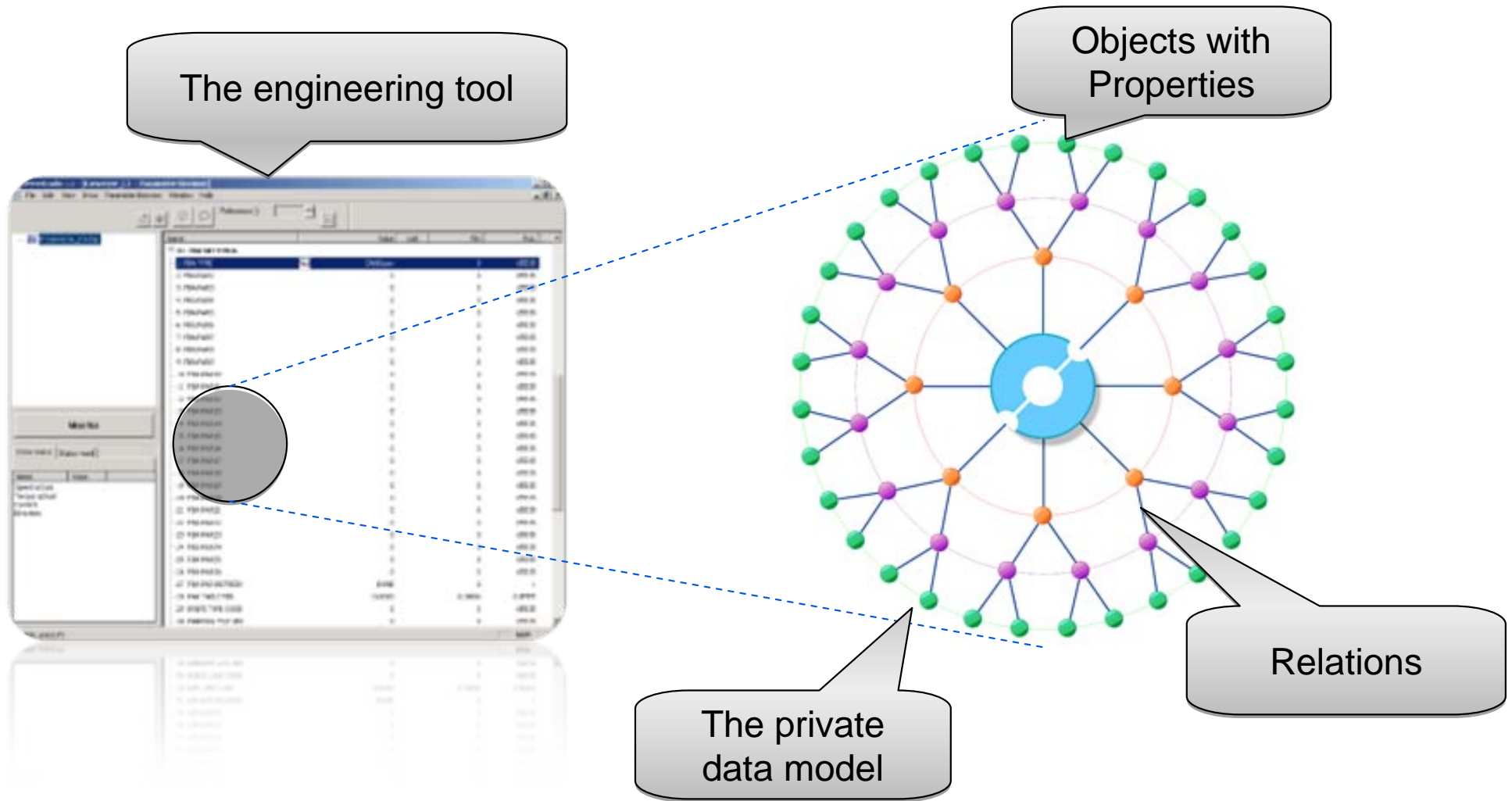
The remaining gap

| Domain | Syntax | Semantics |
|--|--------|-----------|
| Geometrie: COLLADA (closed data model) | X | X |
| Logic: PLCOpen XML (closed data model) | X | X |
| Object structures: CAEX (meta model) | X | ? |

Introduction

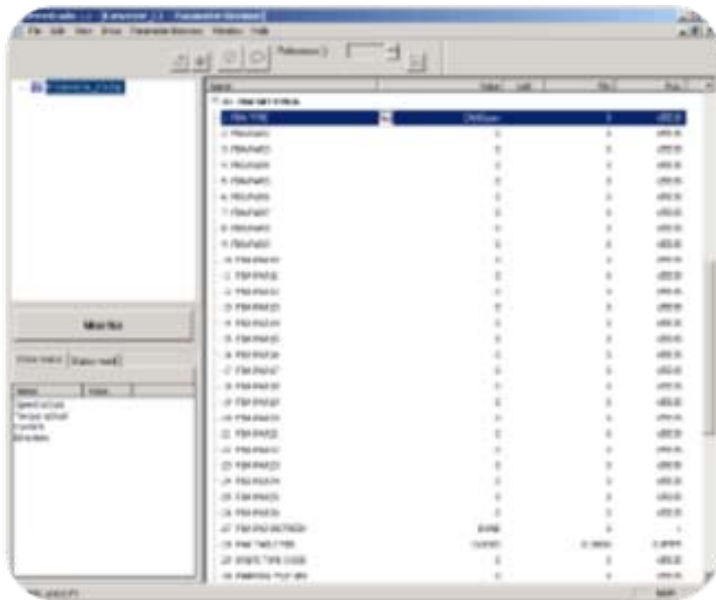
What are we talking about

A data model: The concept



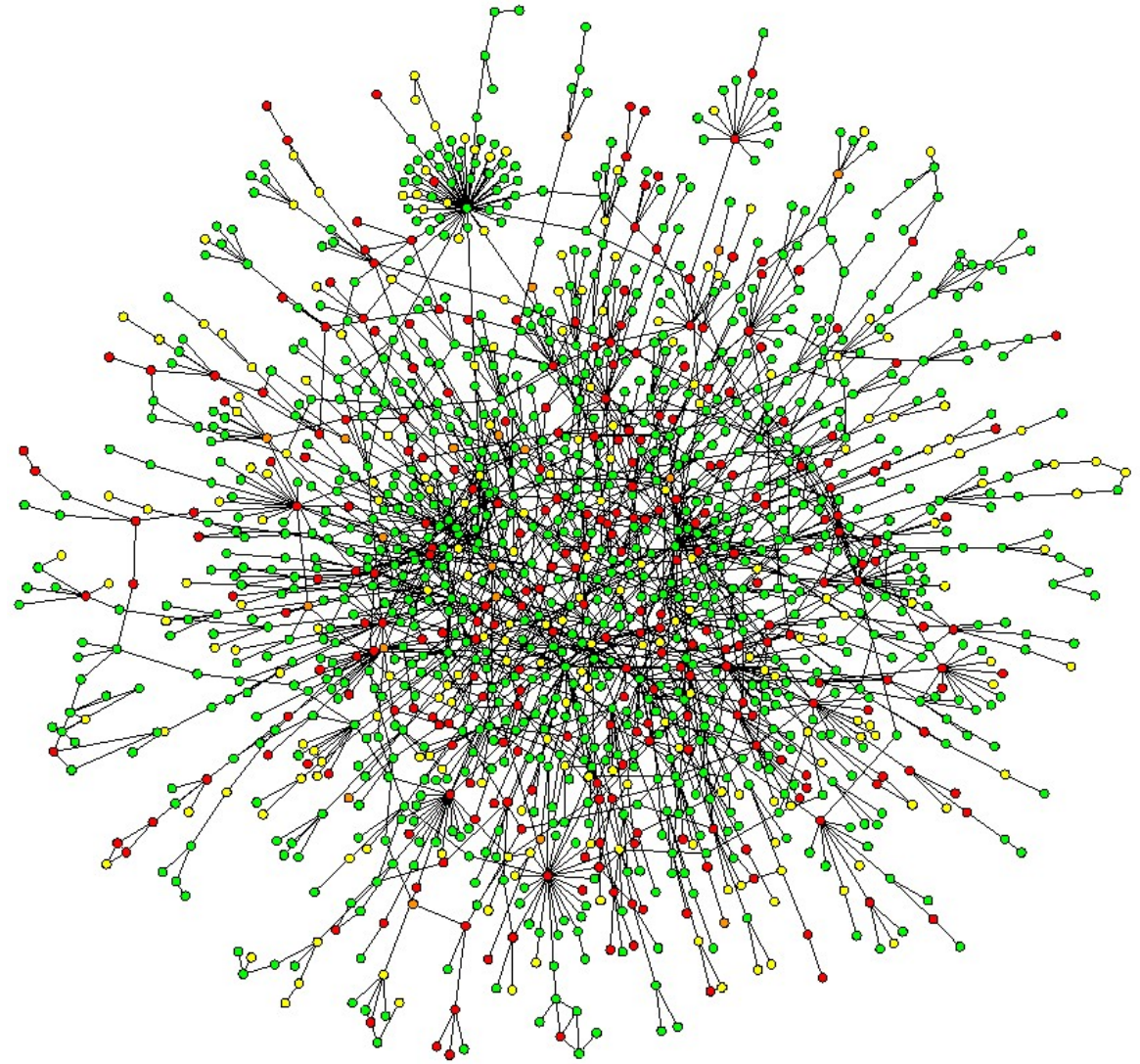
What are we talking about

A data model: The reality



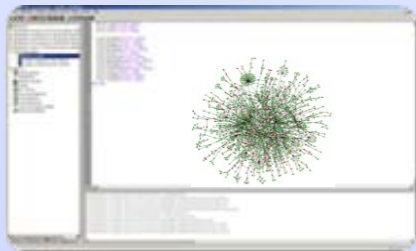
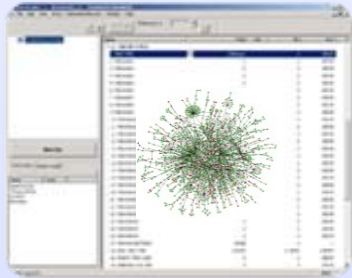
The screenshot shows a software window with a menu bar (File, Edit, View, Tools, Database, Window, Help) and a toolbar. Below the toolbar is a panel with a 'Database' dropdown and a 'Table' dropdown. The main area displays a table with columns for 'ID', 'Name', 'Status', 'Age', 'Gender', 'Height', 'Weight', 'Blood Pressure', 'Heart Rate', 'Cholesterol', 'Glucose', and 'Smoking'. The table contains 20 rows of data.

| ID | Name | Status | Age | Gender | Height | Weight | Blood Pressure | Heart Rate | Cholesterol | Glucose | Smoking |
|----|---------------|--------|-----|--------|--------|--------|----------------|------------|-------------|---------|---------|
| 1 | John Doe | Male | 35 | Male | 175 | 70 | 120/80 | 75 | 200 | 100 | Yes |
| 2 | Jane Smith | Female | 28 | Female | 160 | 55 | 110/70 | 65 | 150 | 80 | No |
| 3 | Mike Johnson | Male | 42 | Male | 180 | 85 | 130/90 | 80 | 250 | 120 | Yes |
| 4 | Sarah Brown | Female | 31 | Female | 165 | 60 | 115/75 | 70 | 180 | 90 | No |
| 5 | David Wilson | Male | 25 | Male | 170 | 65 | 125/85 | 70 | 220 | 110 | Yes |
| 6 | Emily Davis | Female | 22 | Female | 155 | 50 | 105/65 | 60 | 140 | 75 | No |
| 7 | Chris Miller | Male | 38 | Male | 178 | 72 | 122/82 | 72 | 190 | 105 | Yes |
| 8 | Amy Taylor | Female | 29 | Female | 162 | 58 | 112/72 | 68 | 160 | 85 | No |
| 9 | Robert Lee | Male | 45 | Male | 185 | 90 | 135/95 | 85 | 280 | 130 | Yes |
| 10 | Lisa White | Female | 33 | Female | 168 | 62 | 118/78 | 72 | 170 | 95 | No |
| 11 | Kevin Green | Male | 27 | Male | 172 | 68 | 128/88 | 75 | 210 | 115 | Yes |
| 12 | Nicole Black | Female | 24 | Female | 158 | 52 | 108/68 | 62 | 150 | 80 | No |
| 13 | Brandon Hall | Male | 36 | Male | 176 | 70 | 124/84 | 74 | 200 | 110 | Yes |
| 14 | Sophia King | Female | 30 | Female | 164 | 60 | 114/74 | 70 | 165 | 90 | No |
| 15 | Tyler Scott | Male | 26 | Male | 171 | 66 | 126/86 | 71 | 215 | 112 | Yes |
| 16 | Hannah Adams | Female | 23 | Female | 156 | 51 | 106/66 | 61 | 145 | 78 | No |
| 17 | Justin Baker | Male | 39 | Male | 179 | 73 | 123/83 | 73 | 195 | 108 | Yes |
| 18 | Megan Clark | Female | 32 | Female | 166 | 61 | 116/76 | 71 | 175 | 92 | No |
| 19 | Anthony Evans | Male | 41 | Male | 182 | 88 | 132/92 | 82 | 260 | 125 | Yes |
| 20 | Olivia Harris | Female | 28 | Female | 161 | 57 | 111/71 | 69 | 155 | 82 | No |

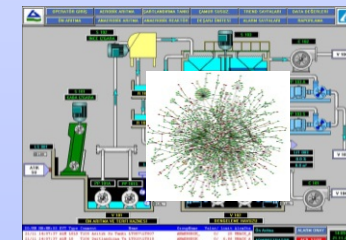
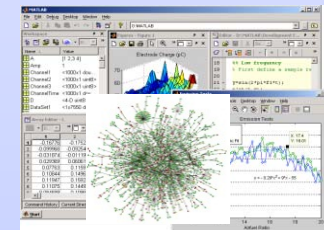
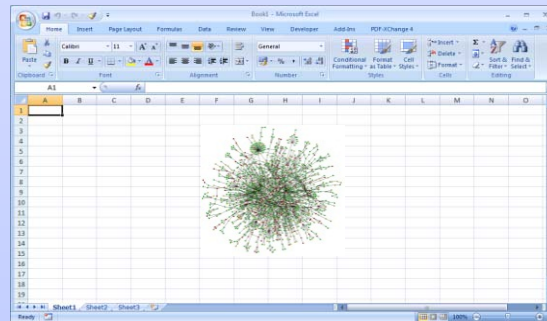
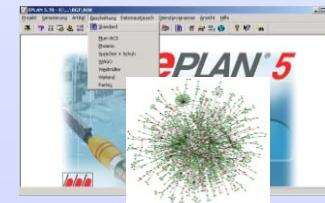
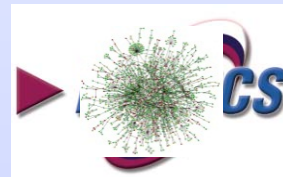
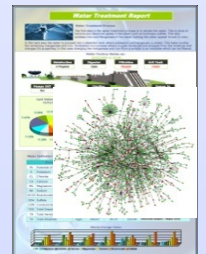
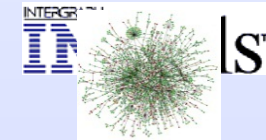
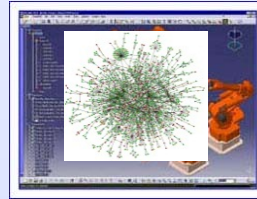
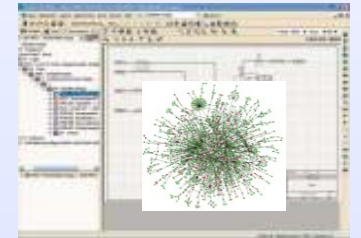
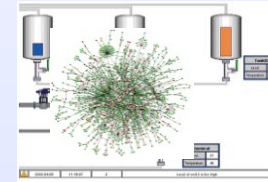


Heterogeneous tool landscape

ABB



logi.CAD



ABB

What we already tried

Heterogeneous tool landscape

Data exchange across tools

Approach 2: Lose coupling

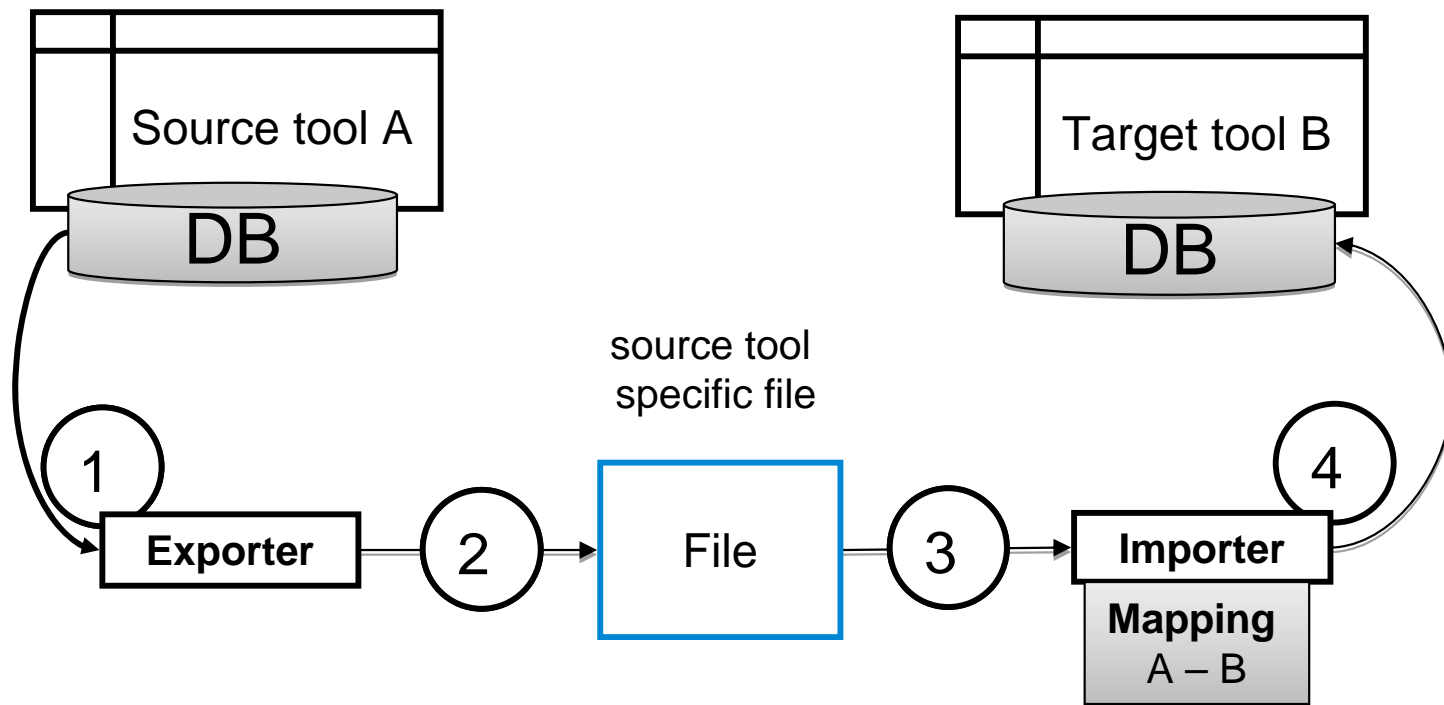
- Exchange of files
- Nice for tools vendors
- Typical questions for the users
 - Responsibility for the data
 - Change management
 - Tracking of changes
 - Work with branching

Approach 1: Deep integration

- Common database
- Requires engineering tools that are developed in a harmonized way across vendors
- Nice for the users
- Typical questions for tool vendors:
 - Harmonization effort
 - Innovation speed
 - Development and maintenance costs

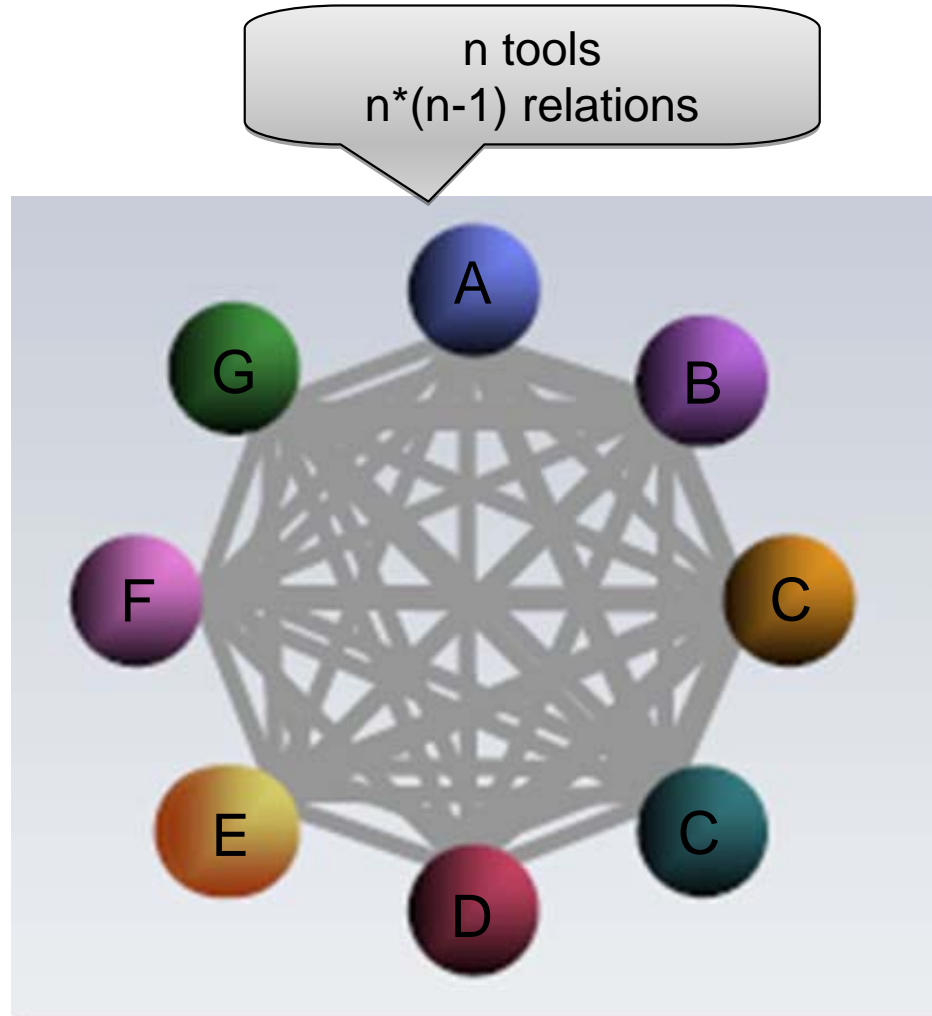
History of pairwise data exchange

Step 1



History of pairwise data exchange

Step 2

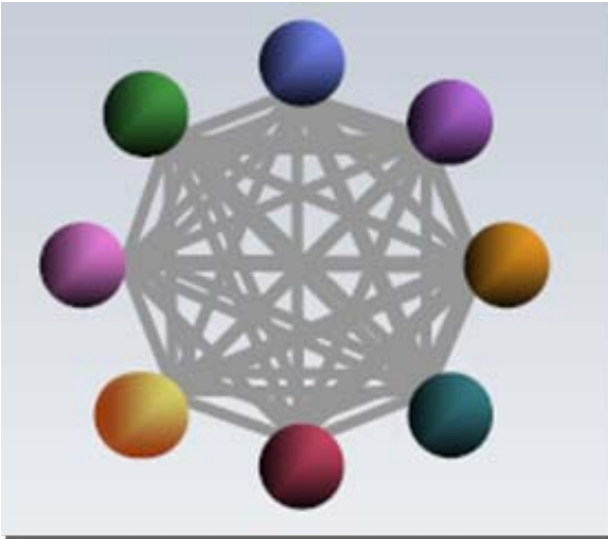


History of pairwise data exchange

Step 3

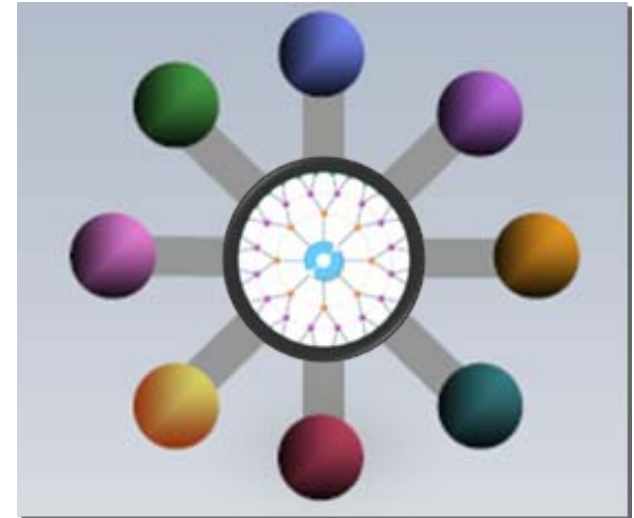
n tools
 $n*(n-1)$ relations

Today



n tools
 $2*n$ relations

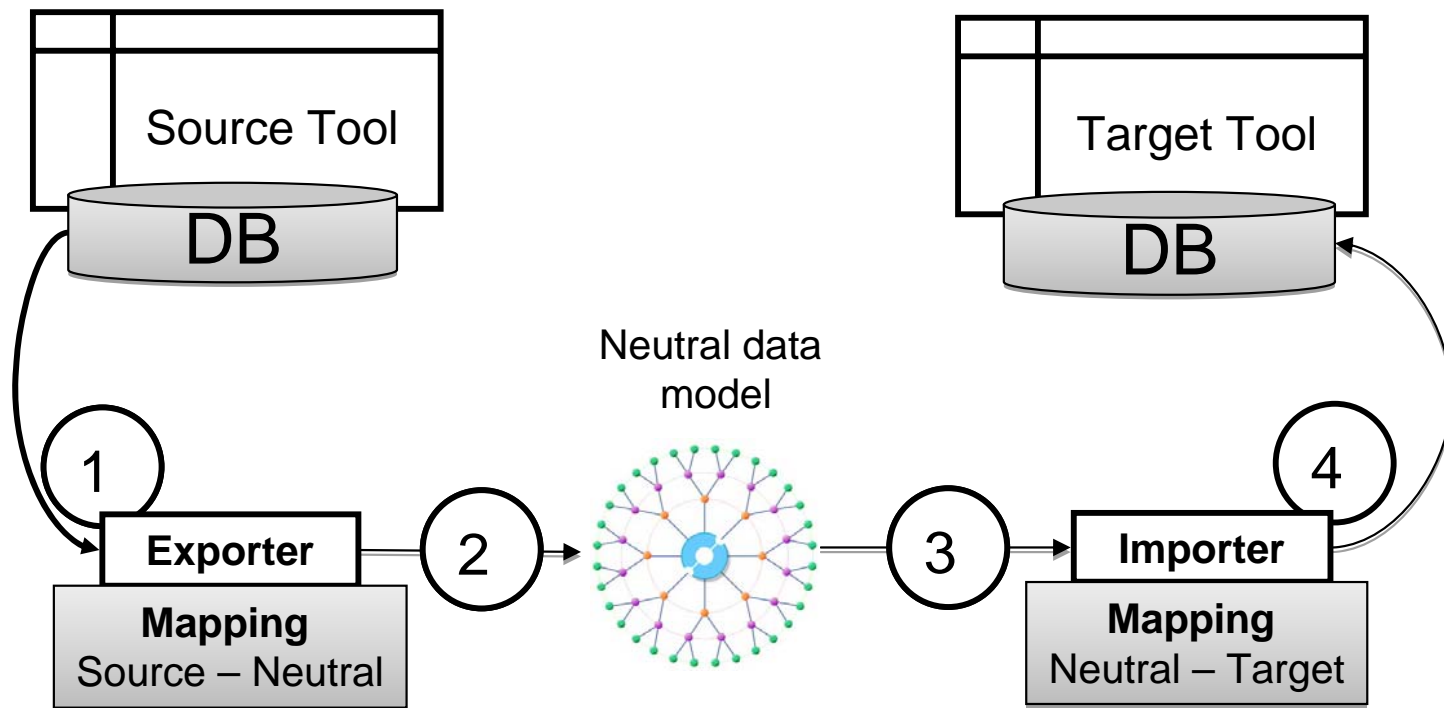
Future



Advantage: Just one single import/export
per engineering tool

History of pairwise data exchange

Step 4



Looks nice,
but does it work?

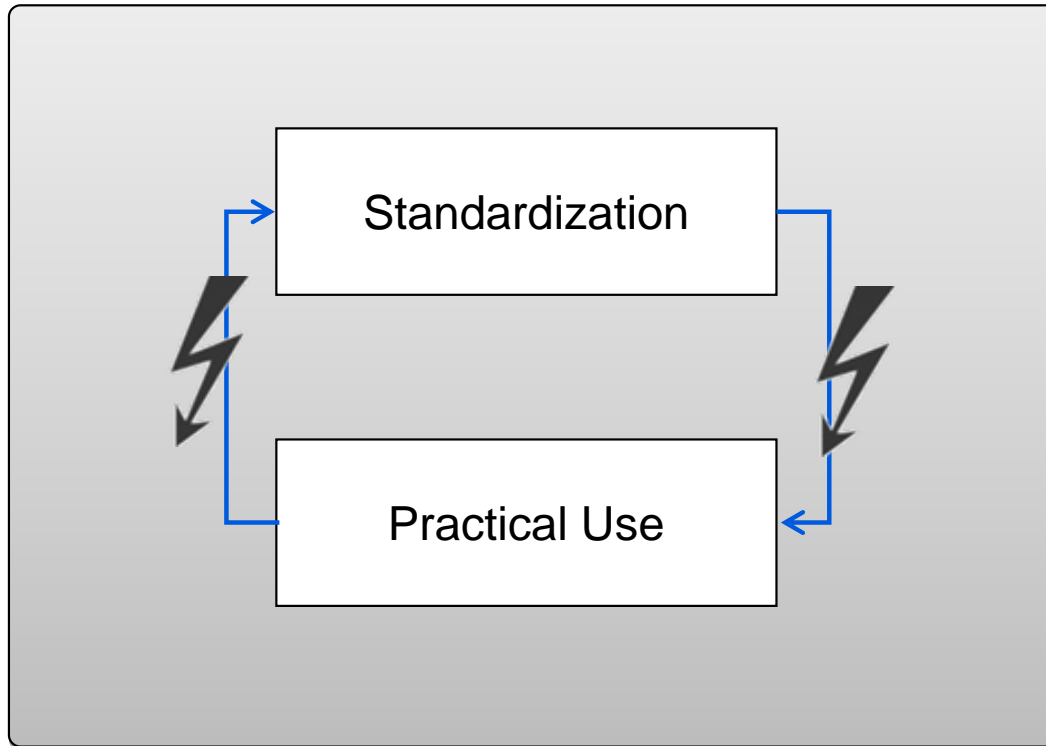
Steps for semantic standardization

The standardization procedure is a long term activity

1. • Find Experts for each participating engineering tool
2. • Agreement on „common concepts“ across all participants
3. • Development of a neutral common data model (UML?)
4. • Physical implementation of the common data model (XML?)
5. • Develop a document describing the common data model (doc?)
6. • Provide enough experts that know the standard
7. • Provide stability of the standard and keep all experts up to date
8. • Make the standard accessible and usable to everybody
9. • Provide software solutions for it (importer, exporter)

Semantic standardization does not work today

The feedback loop is not closed



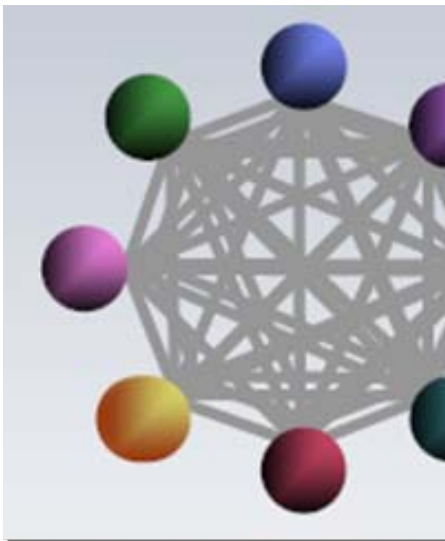
- Closing the standardization feedback loop is difficult
 - Standardization waits for feedback from users and tool vendors
 - Tool vendors wait for final standardization
 - Resulting in a deadlock situation
- Standardization of data models cannot be achieved in one step



The challenge

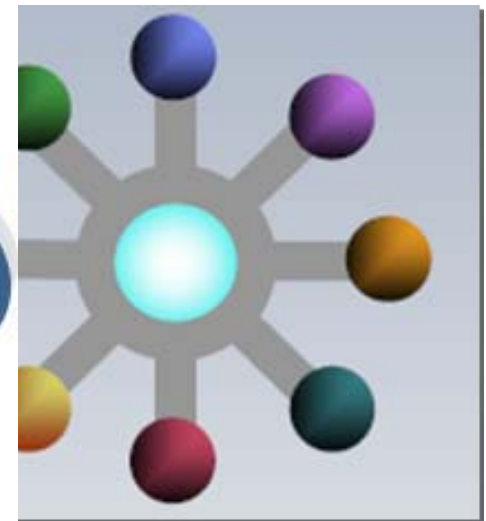
Data integration in a heterogeneous landscape

Today



0% standardized data model

Future



100% standardized data model

Not achievable
in one step !!!

The idea

Lets take some insides

Were do we agree

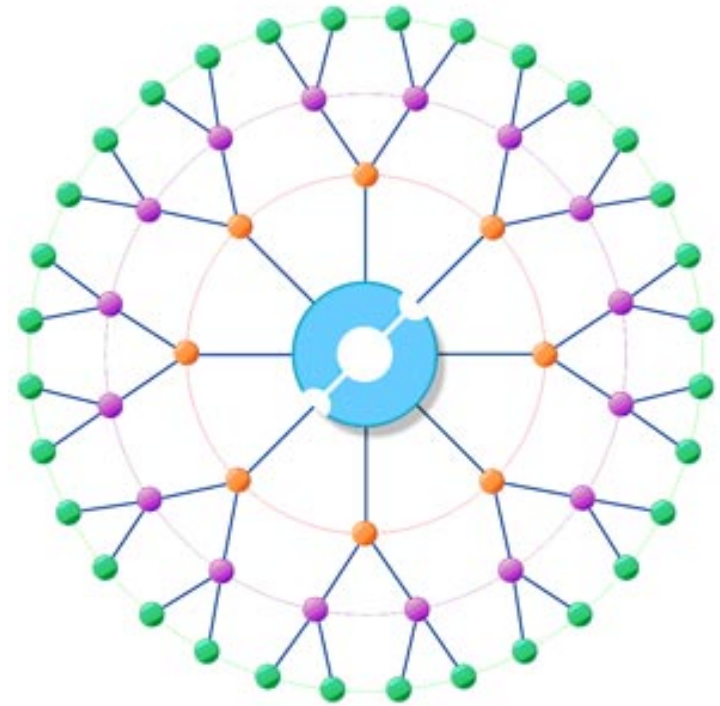
- We accept that tools and data models are heterogeneous.
- We accept that an agreement of a common data model does not exist.
- We accept that development of common data models is a long term standardization activity.
- We accept that bidirectional data exchange across all thinkable domains does not reflect the needs of the reality.
- Data integration requires in most cases only a subset of the theoretical interconnections

The idea

We actively allow mixed neutral/private data models



Standardization level = 0 %



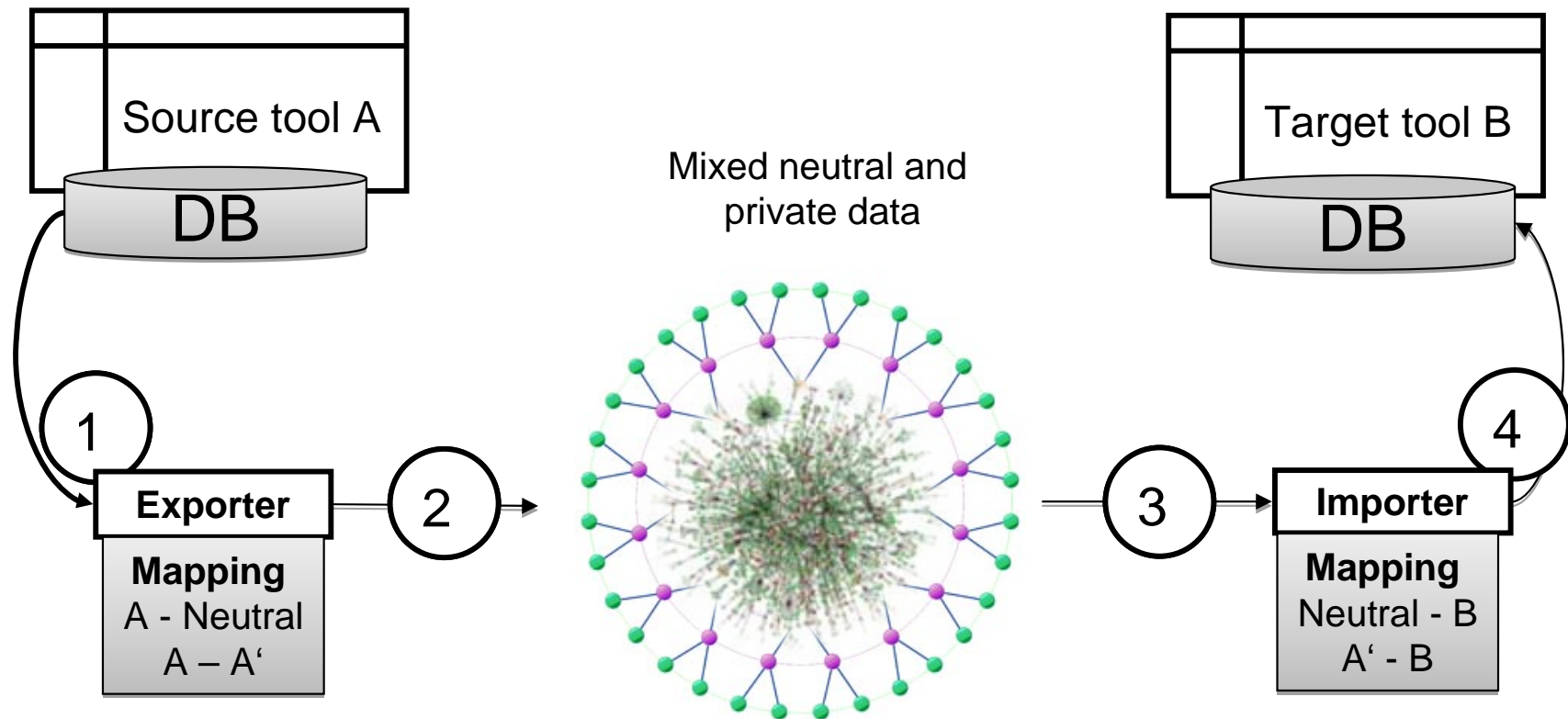
0% < Standardization level < 100%



Standardization level = 100%

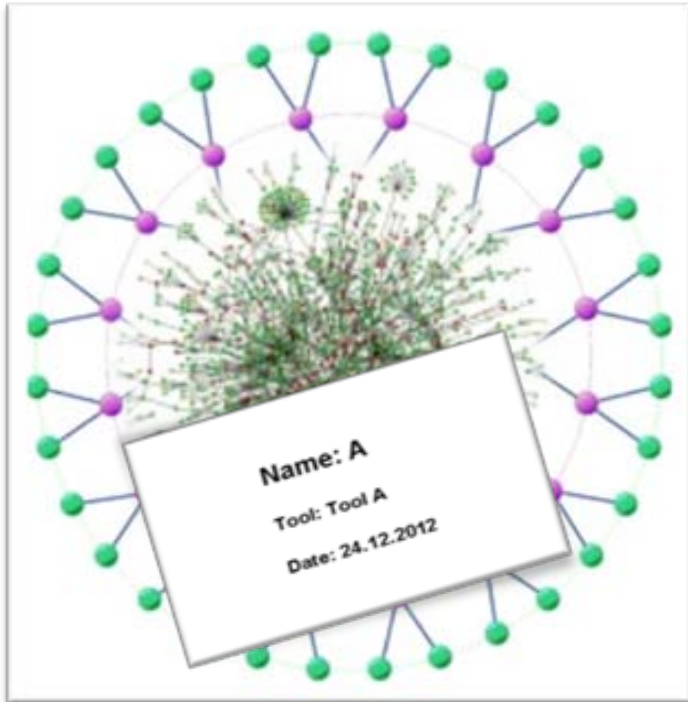
The idea

We actively allow mixed neutral/private data models



The trick

Putting a label on the neutral file

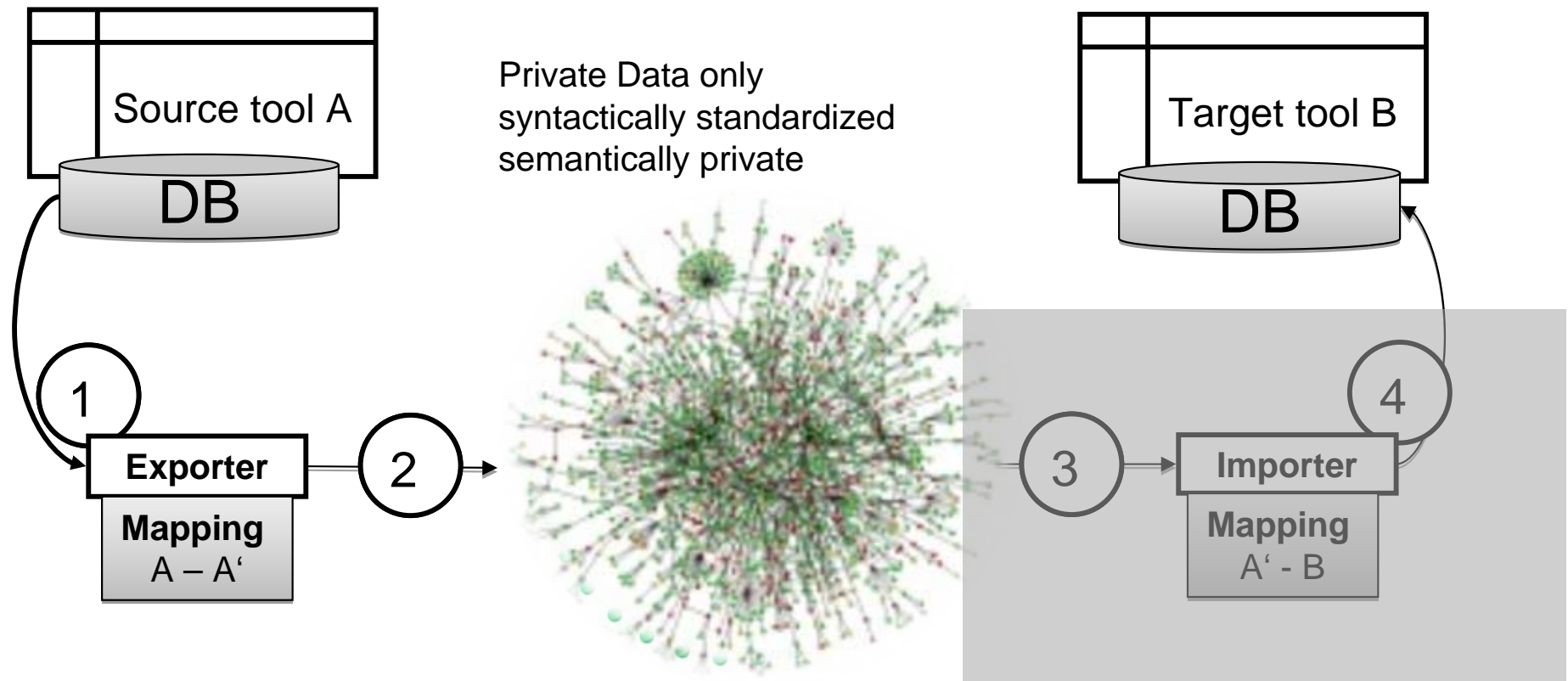


| XML tag name | Example |
|---------------------|------------------------------|
| WriterName | "a Source Tool" |
| WriterID | "a Source Tool" |
| WriterVendor | "a company" |
| WriterVendorURL | "www.acompany.com" |
| WriterVersion | "1.0" |
| WriterRelease | "1.0.1" |
| LastWritingDateTime | "2012-02-01T16:23:00" |
| WriterProjectTitle | "eCarproduction" |
| WriterProjectID | "eCarproduction_LinePLC.prj" |

Maturity level 1

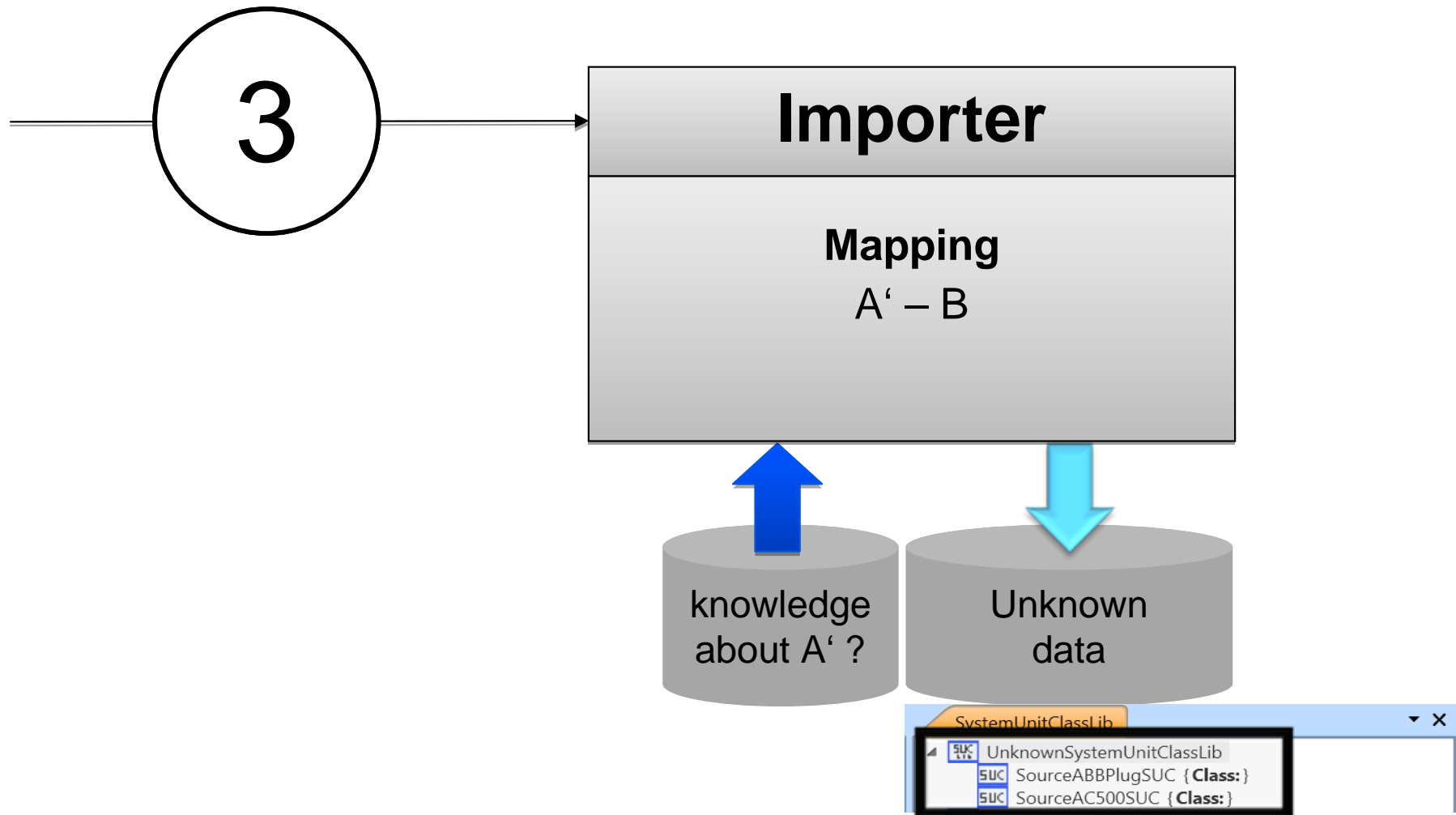
Data exchange between engineering tools

Maturity level 1



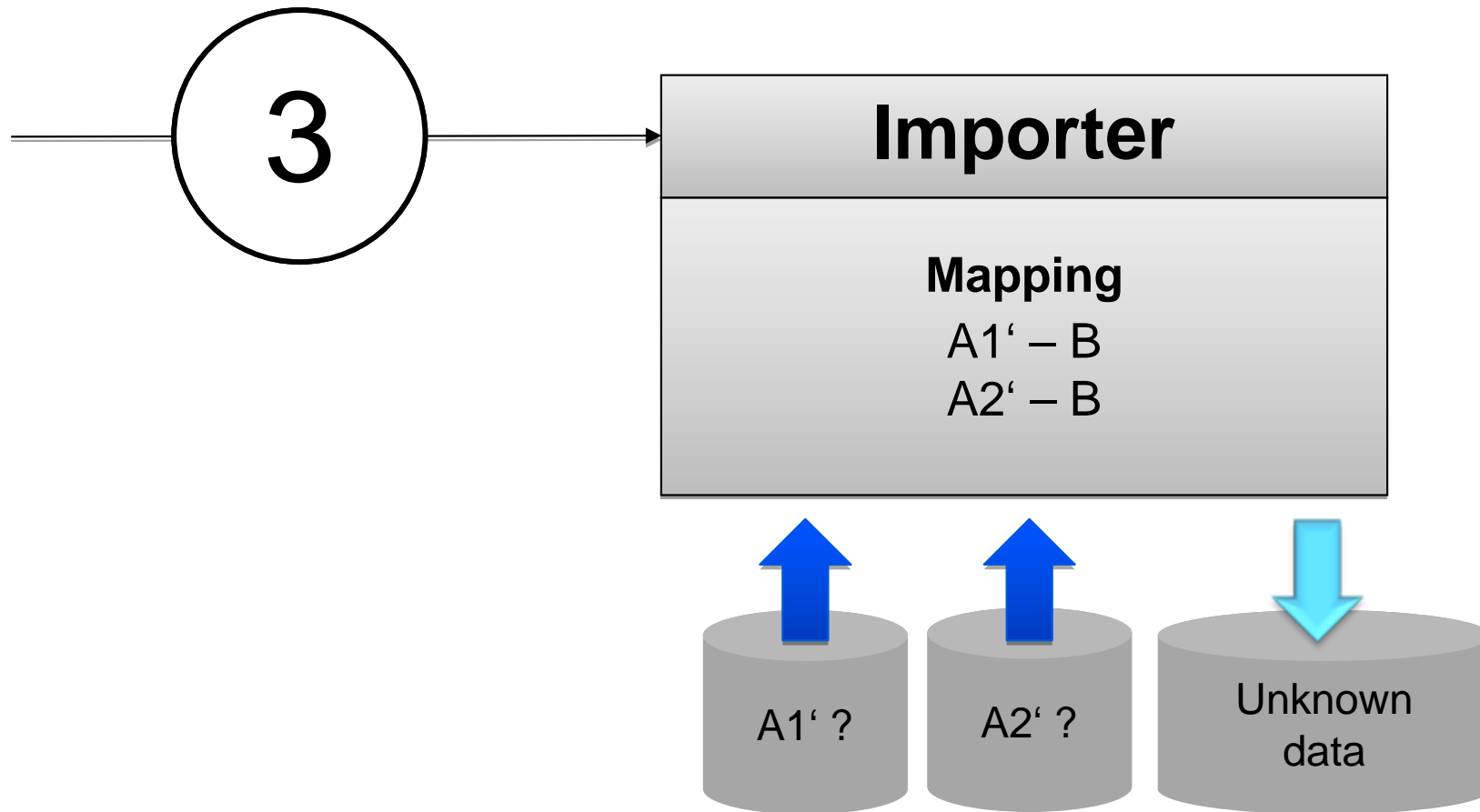
Data exchange between engineering tools

Maturity level 1



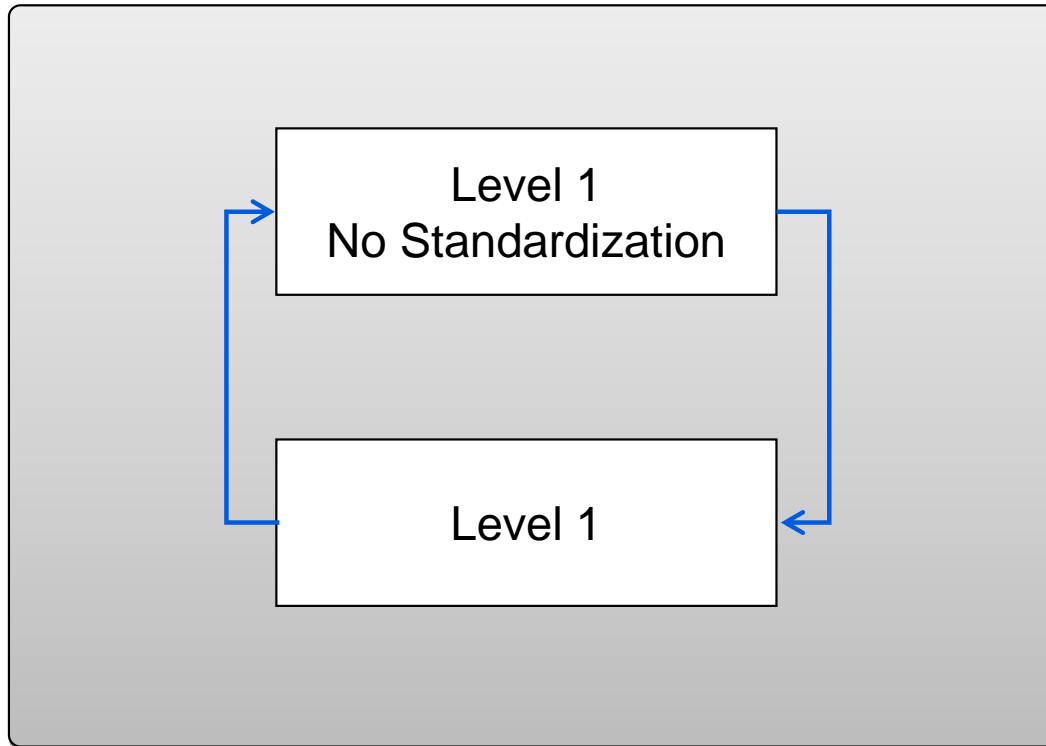
Data exchange between engineering tools

Maturity level 1



Standardization feedback loop

Maturity level 1



- Closing the standardization feedback loop
 - Makes data models explicitly „visible“
 - Simplifies exporter/importer development
 - Simplifies comparison between A and B



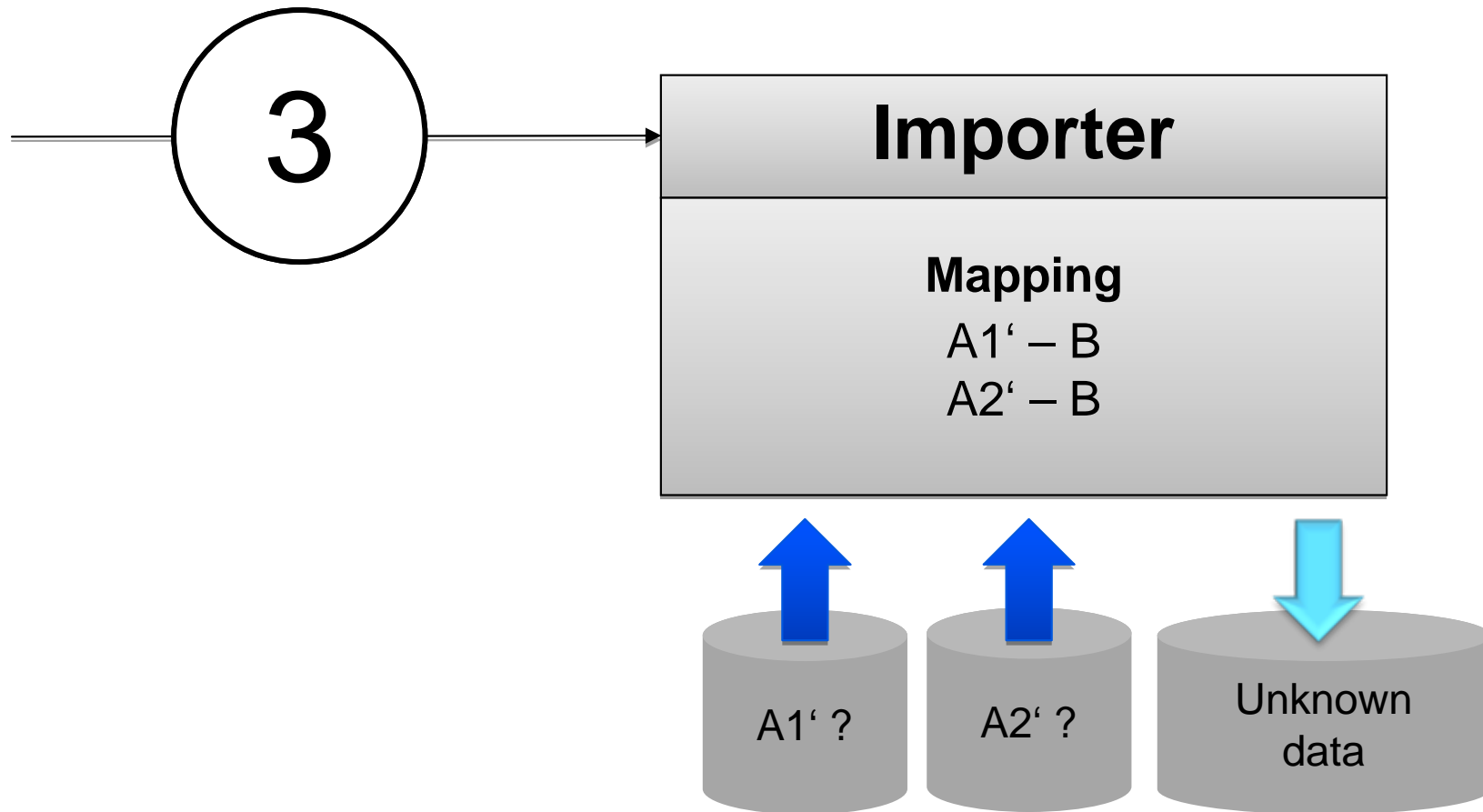
Semantic standardization level = 0 %

Initiate and motivate data exchange of object models with AutomationML based on standard syntax but proprietary semantic

Maturity level 2

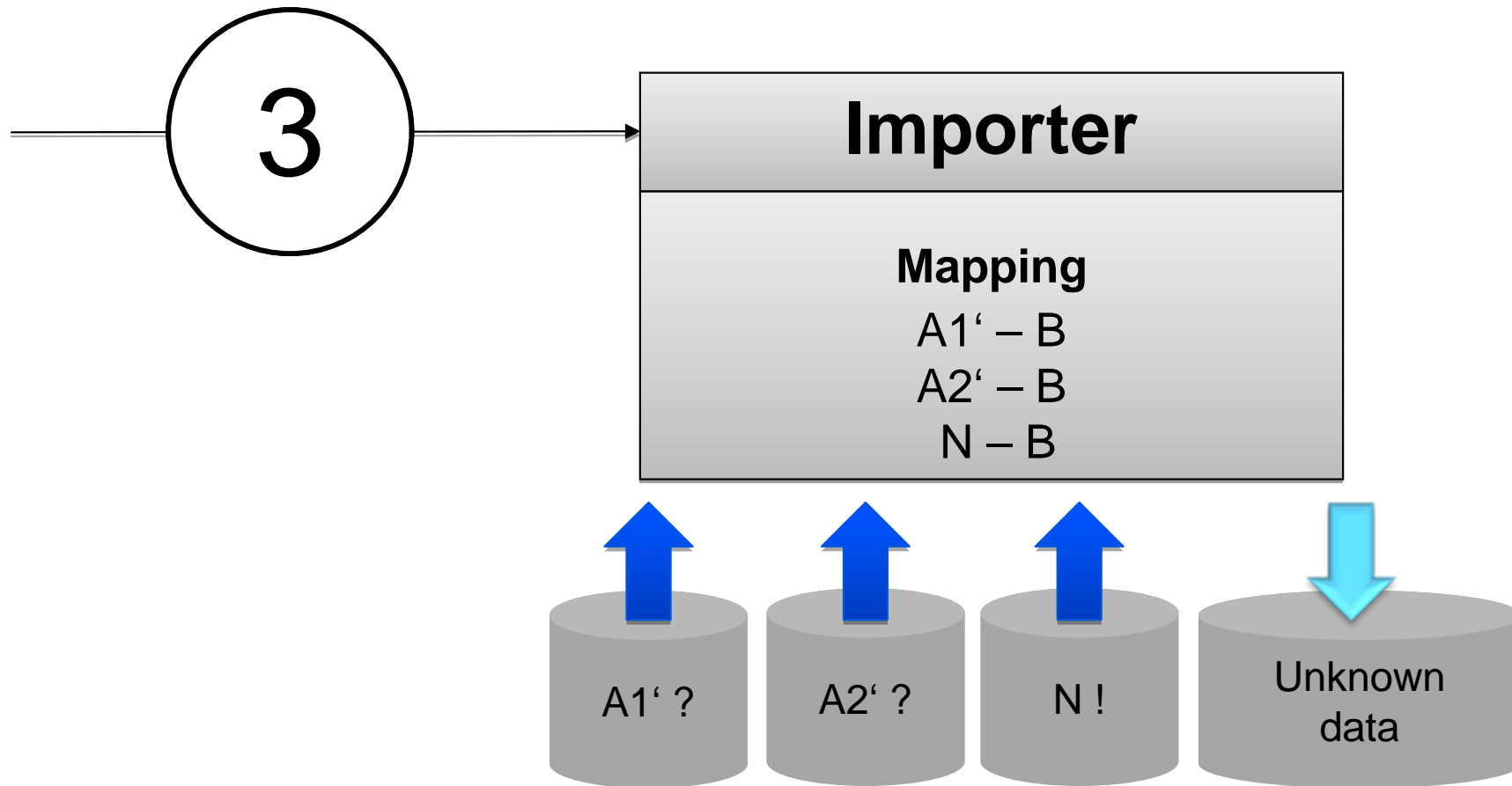
Data exchange between engineering tools

Maturity level 1



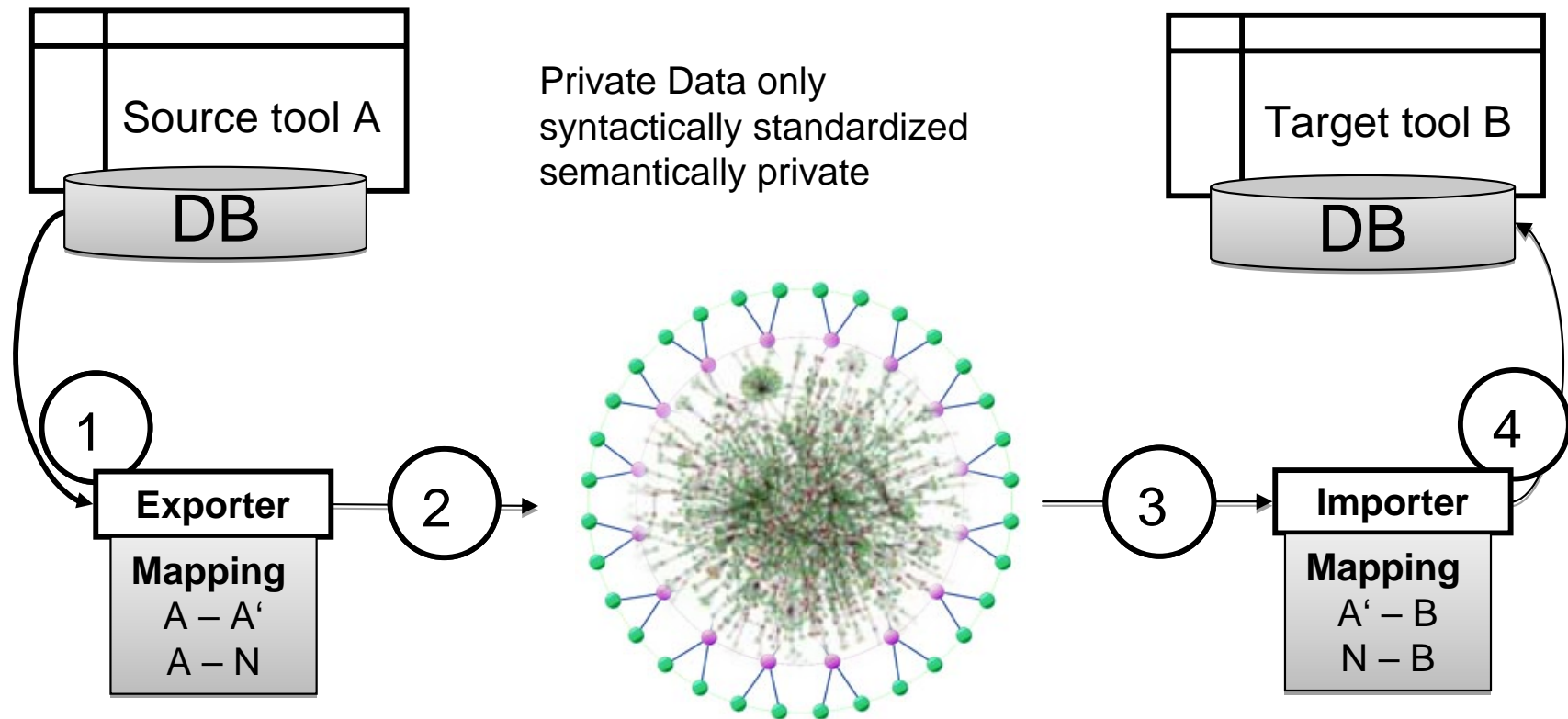
Data exchange between engineering tools

Maturity level 2



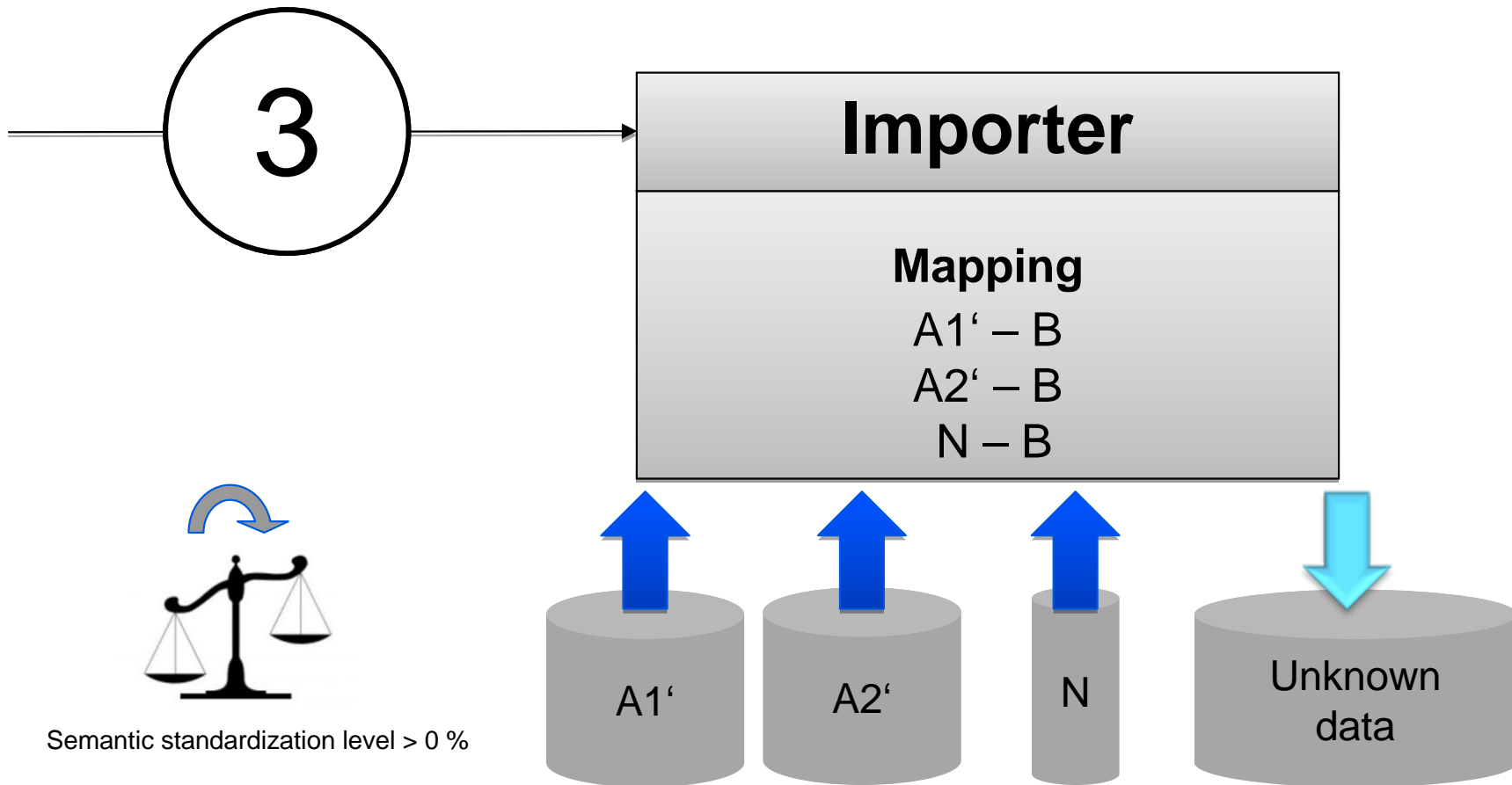
Data exchange between engineering tools

Maturity level 2



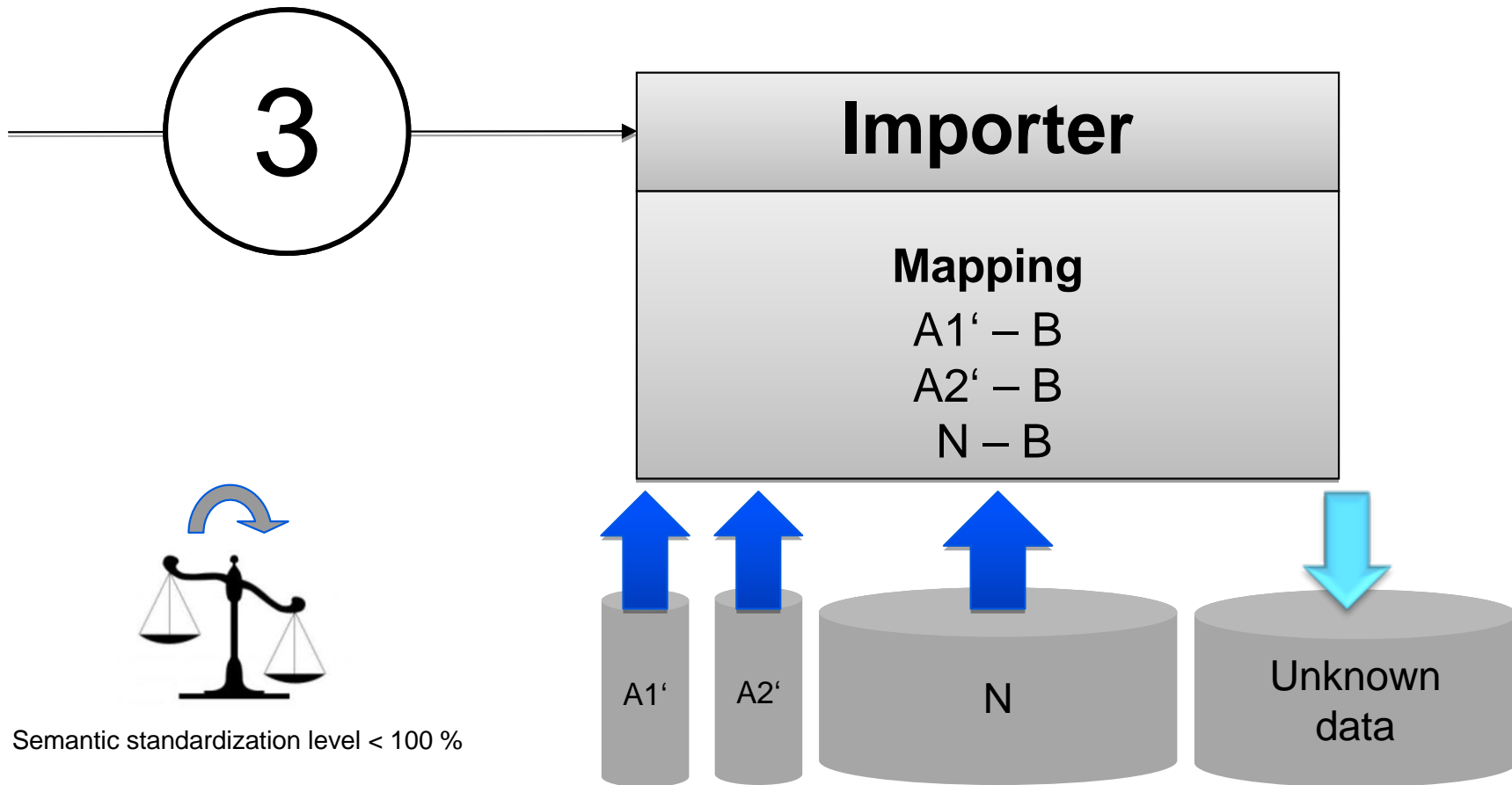
Data exchange between engineering tools

Maturity level 2



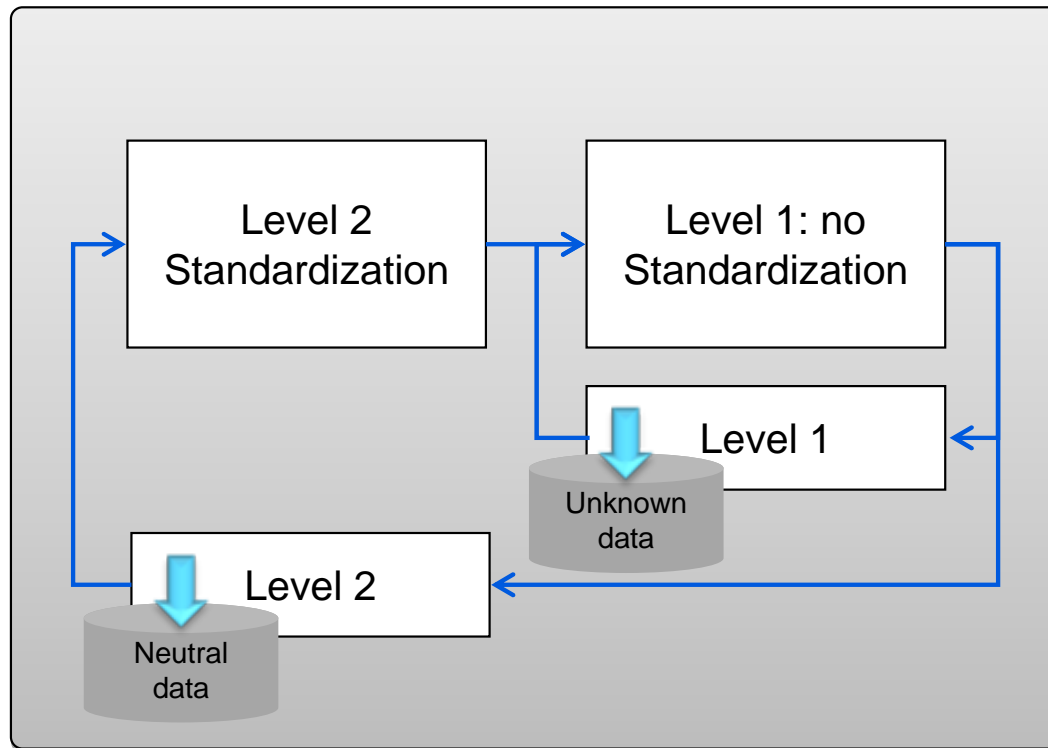
Data exchange between engineering tools

Maturity level 2



Standardization feedback loop

Maturity level 2











- Advantages of mixed private/standardized data models
 - Visibility, knowledge about „unknown data“
 - Simplifies standardization
 - Allows automatic derivation of standardization needs
 - Allows automatic prioritization of standardization needs



0% < Semantic standardization level < 100%

Steps for semantic standardization

The standardization procedure is a long term activity

1. Find Experts for each participating engineering tool 
2. Agreement on „common concepts“ across all participants 
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5. Develop a document describing the common data model (doc?) 
6. Provide enough experts that know the standard 
7. Provide stability of the standard and keep all experts up to date 
8. ~~Make the standard accessible and usable to everybody~~
9. Provide software solutions for it (importer, exporter) 

Summary

Don't wait for semantic standards,
there is a solution available
based on today's AutomationML

See in Part II by Rainer Drath
how to achieve iterative data exchange
in a heterogeneous tool landscape

Power and productivity
for a better world™

