Exploring the Future of Digital Twins

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SIRIUS

OSIsoft RESEARCH

Digital Twins

I. Motivators

II. Open challenges

III. Our work & engaging with us

Digital Twins
Now and Tomorrow

The SIRIUS Centre

Eight years' financing from RCN
13 Industrial Partners (11 in 2017)
3 Leading Academic Institutions: Oslo, NTNU Trondheim, Oxford
Centre for Research-Based Innovation
Funding for 20 Ph.D. students
Innovation through prototypes and pilots
45 affiliated researchers

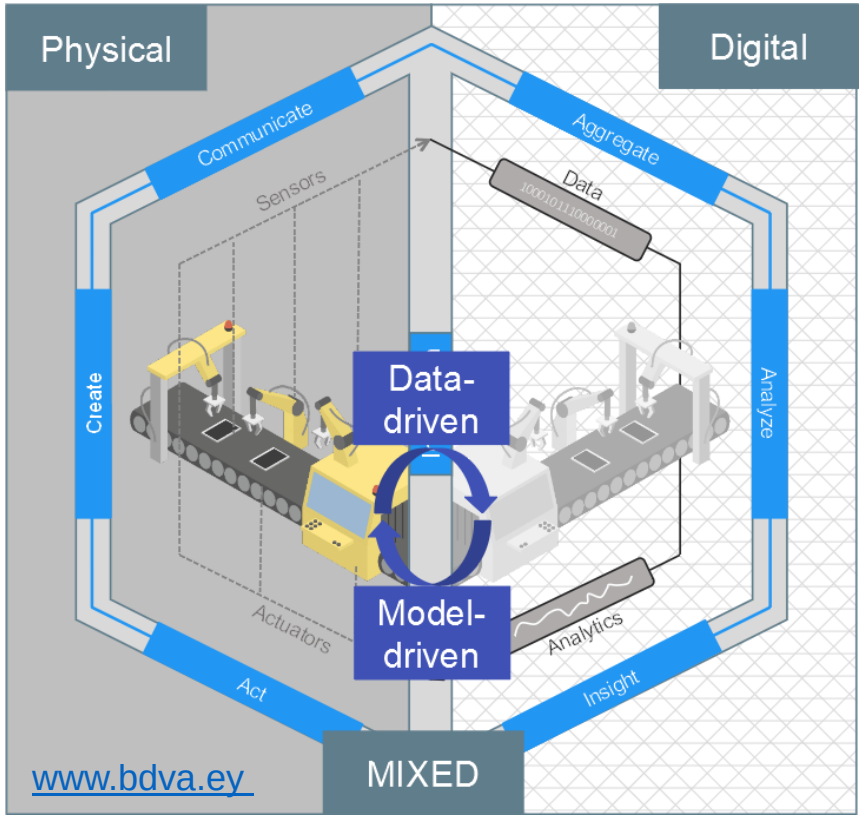
Equinor
DNV GL Schlumberger TechnipFMC
IBM SAP
Computas Evry
Dolphin Interconnect Numascale
Fluid Operations Kadme OSIsoft

What is a Digital Twin?

An integrated

- multi-physics, multi-scale, probabilistic
- simulation of an as-built system, … that uses the best available
- models,
- sensor information, and
- input data to
- mirror and predict activities/performance over the life of its corresponding physical twin

USDOD Procurement Dictionary



Digital Twins – Dream….

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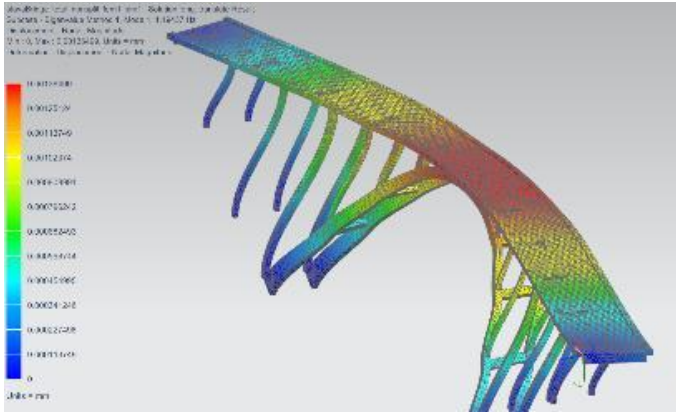

Norwegian Public Roads Administration

… or reality

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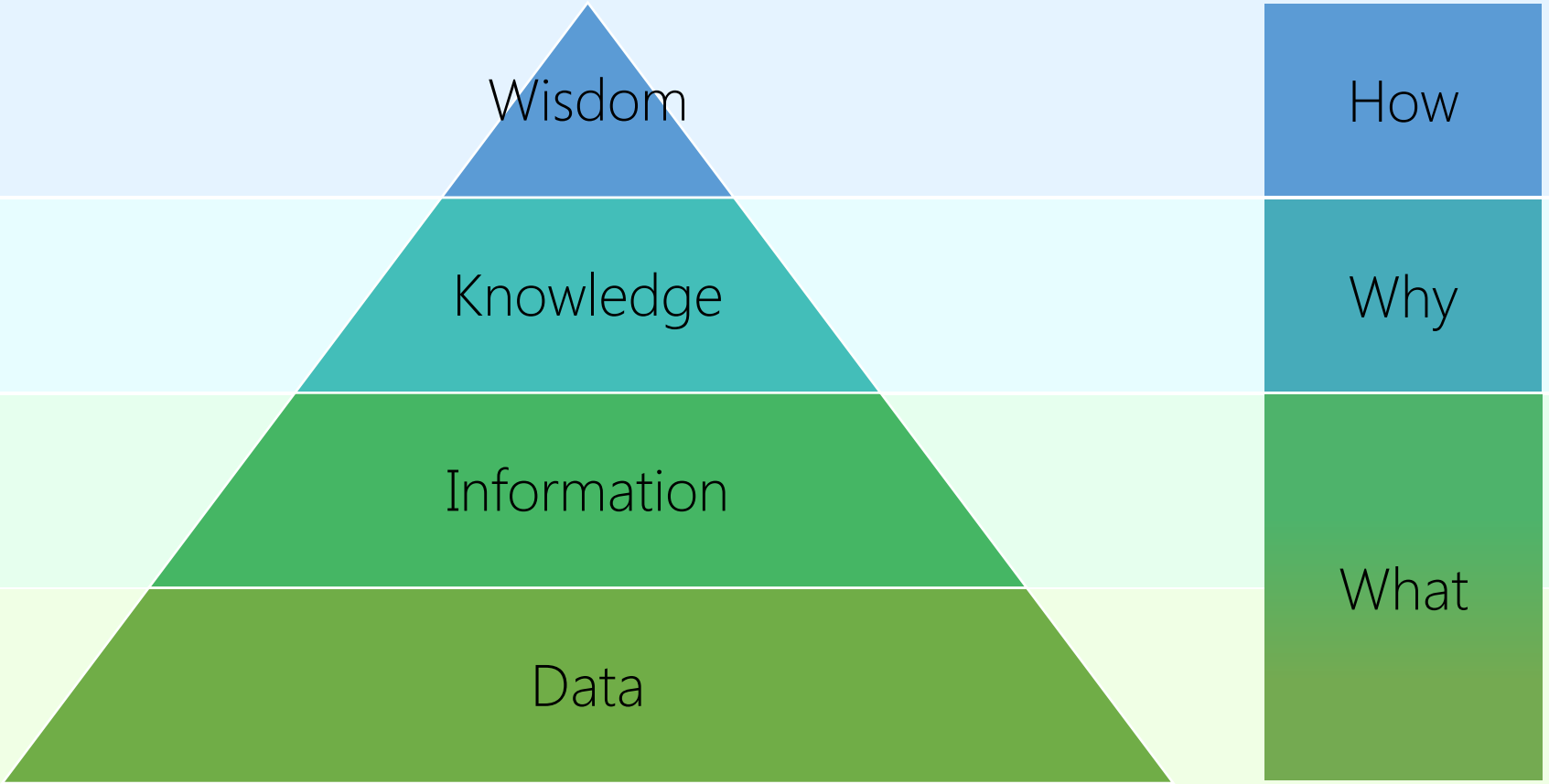
The pains of the digital twin

- Hype and oversell: The top of the Gartner hype curve
- “Everybody” is offering digital twin.
- Concepts driven by aerospace and automotive.
- Fragmented systems, siloed perspectives and overload of data.
- Systems are difficult to configure, maintain and scale.
- Challenges in work practices, security and alignment to business.

Challenges from Industry




Wisdom
Knowledge
Information
Data

Partners in understanding

How to learn valuable new things about our world

- Seeing realistic representations of things and systems
- Answering open-ended or what-if questions
- Receiving predictions or warnings

Cooperative knowledge

How to multiply our knowledge continuously

- Knowing “who to ask” for required knowledge
- Ability to “drop in” new applications onto a Twin
- Not needing to do much integration work

Information exchange

How to communicate meaning

- Breaking down boundaries and silos
- Seeing “your” world-view of the information

Data readiness

How to know what our data streams represent

- Data being semantically well-described
- Everyone contributing to this effort
- Not requiring an ivory tower

Challenges to Technology

Data readiness

How to crowd-source semantic context:

- Accelerating the data-mapping process
- Rewarding contribution
- Addressing the complexity-power balance in ontologies

Information exchange

How to form semantic context into purposeful views

- Meta-understanding the assets and data
- Targeting world-views to consumers

Cooperative knowledge

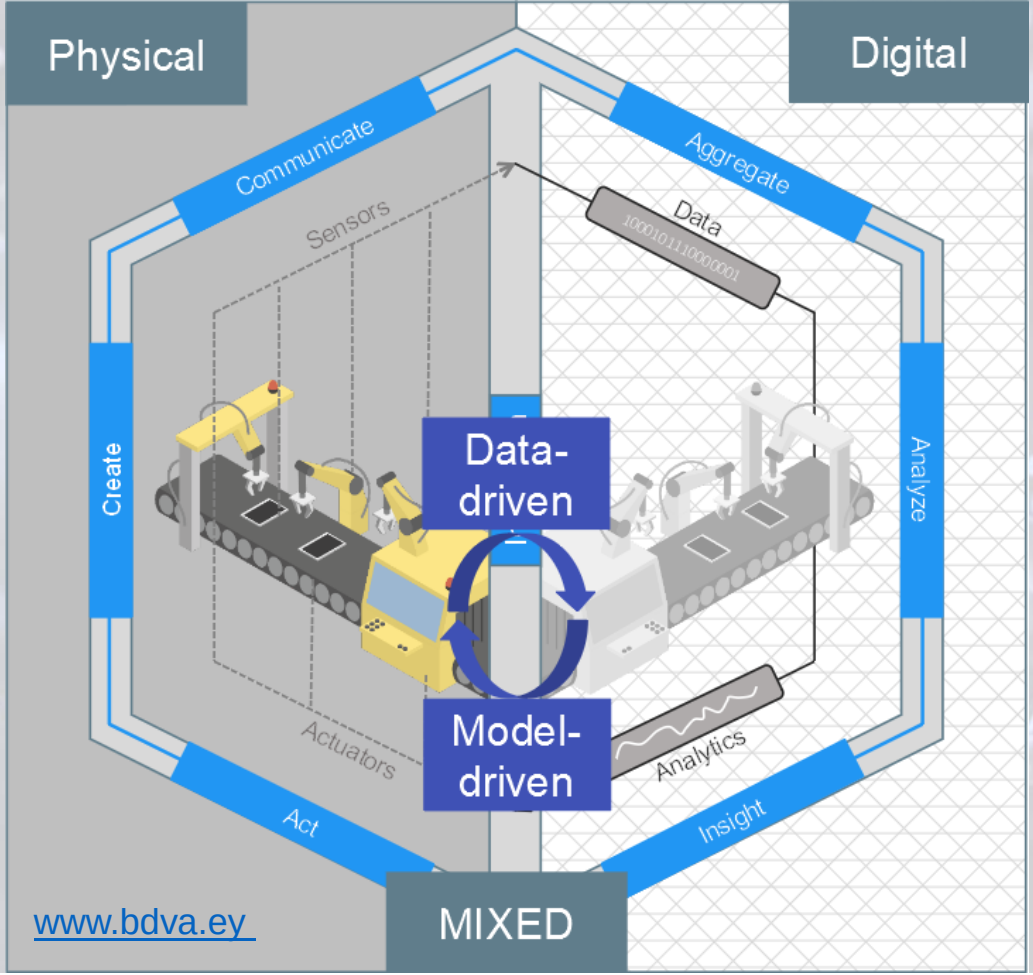
How to get applications collaborating

- Minimizing required integration work
- Forming "teams" around an asset or fleet

Partners in understanding

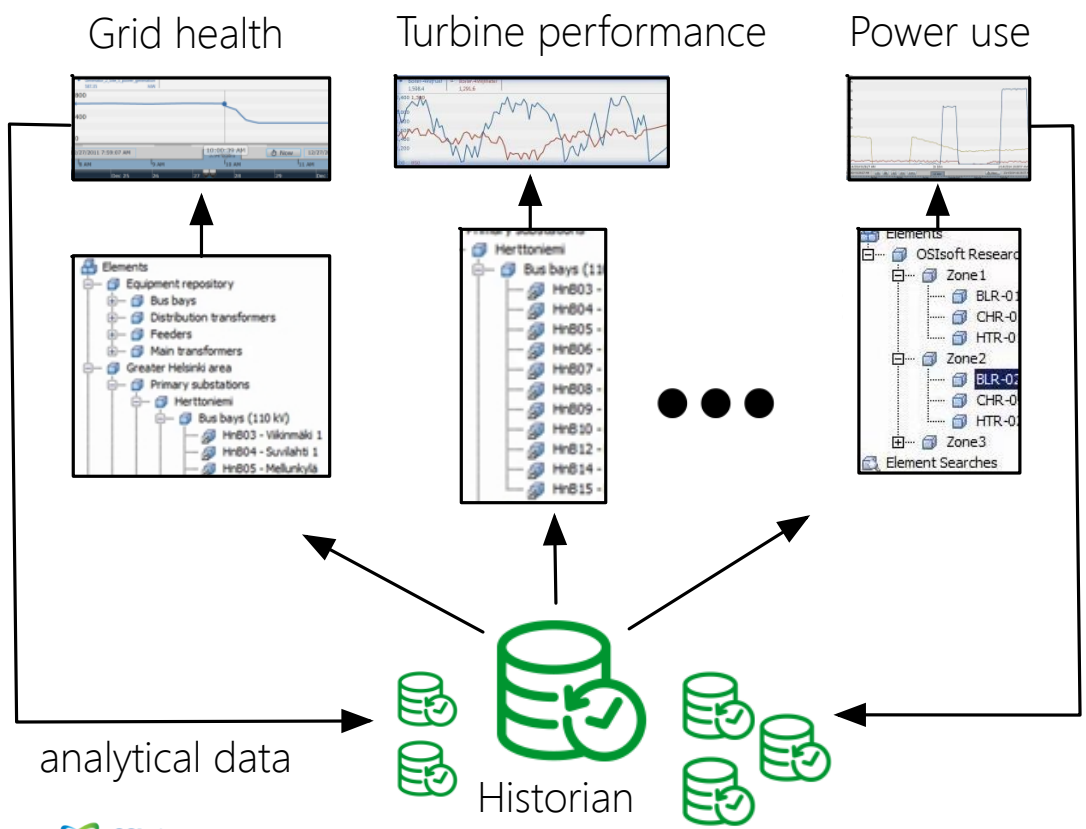
How to augment the physical world

- Mimicking a physical asset (Turing test?)
- Democratizing deep learning and AI
- Blurring the lines between physical and digital



Our Work:
Digital Twins via PI

Specific audience and goals



PI Asset Framework of today

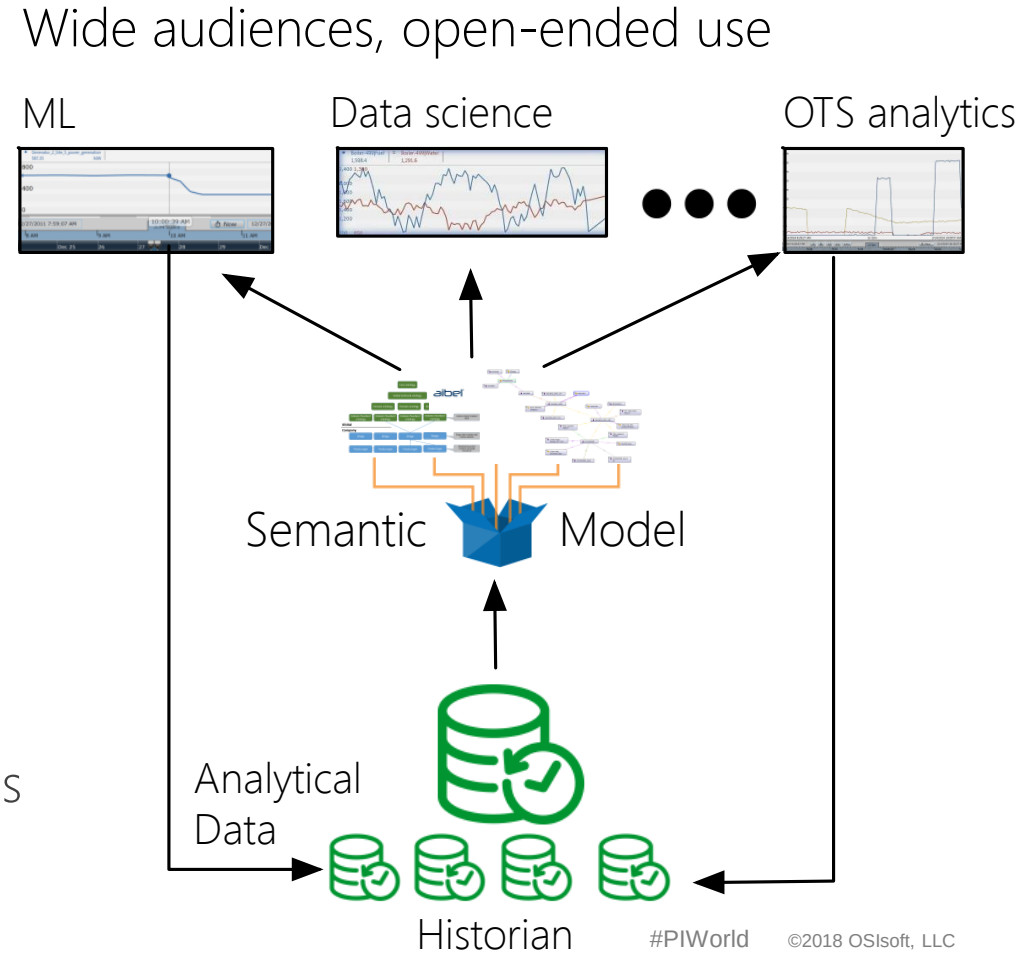
to support process industries, asset models:

- target audiences and goals
- reduce the cost of curiosity
- build bridges across sites

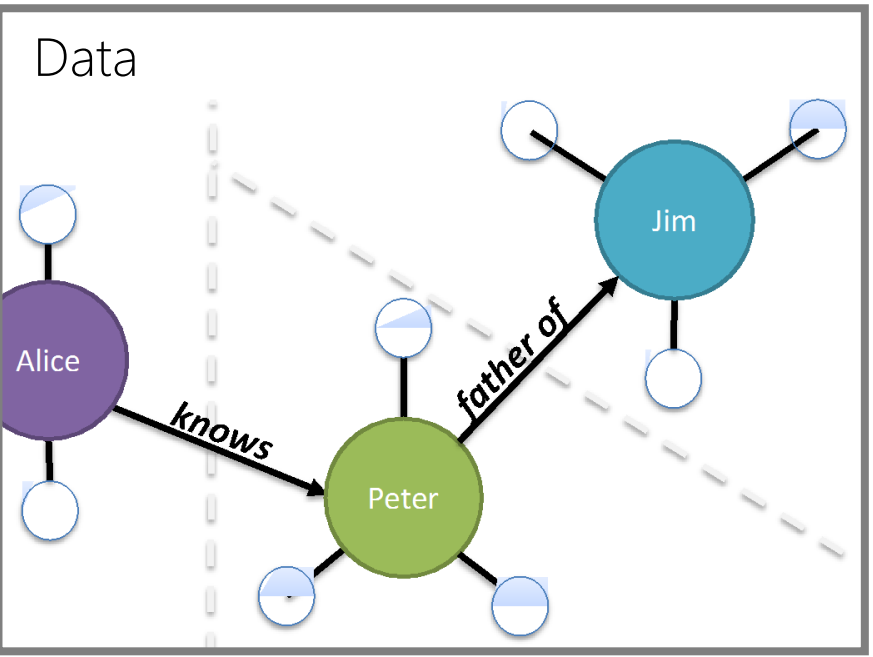
PI Asset Framework of tomorrow?

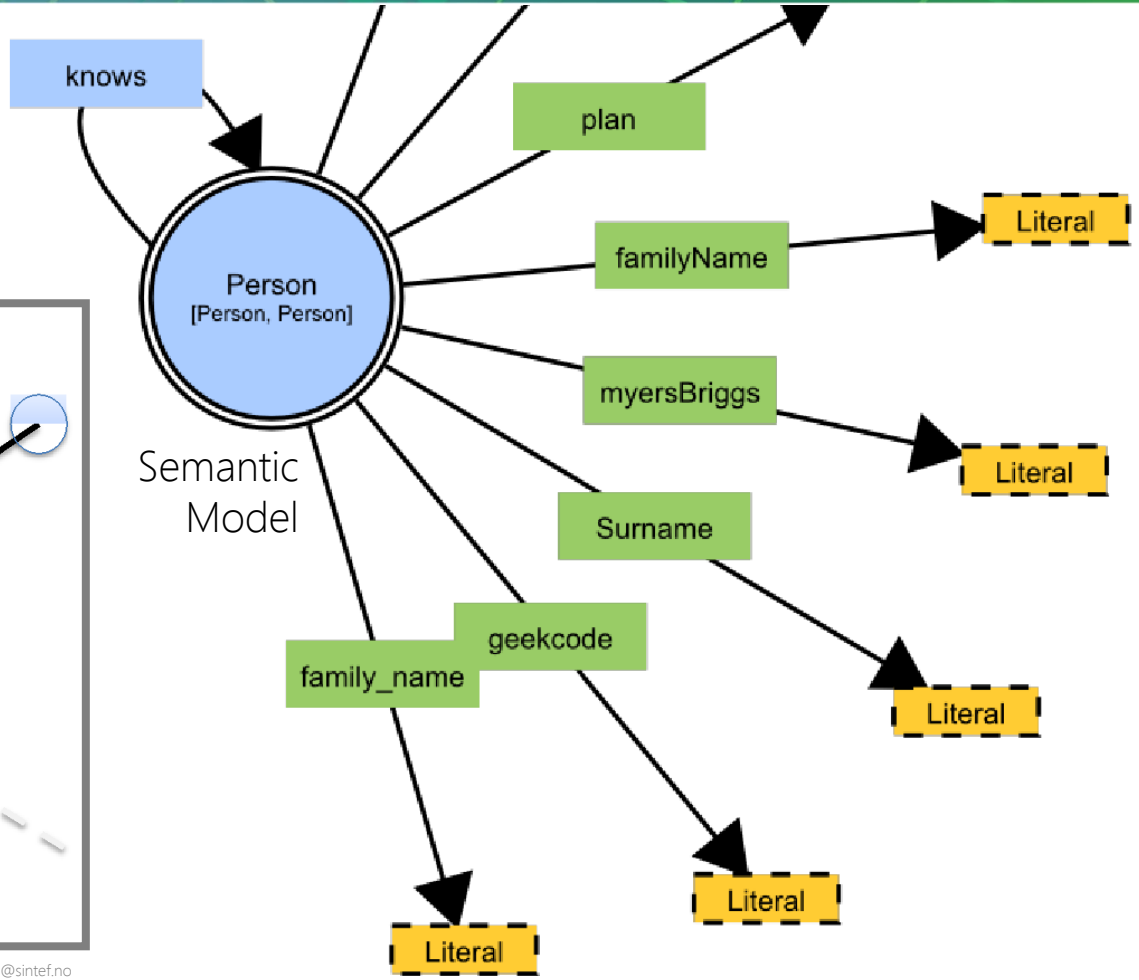
to support Digital Twins, semantic models:

- span audiences and goals
- reduce the cost of integrating new applications
- build bridges across organizations and supply chains



Semantic Models





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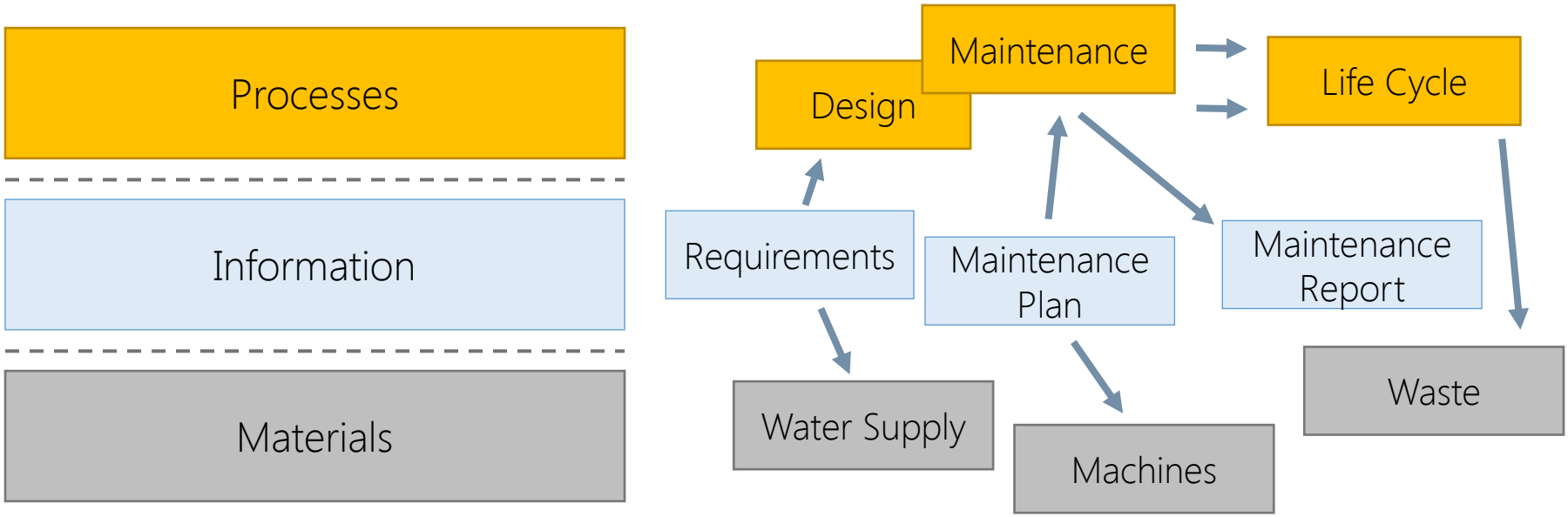
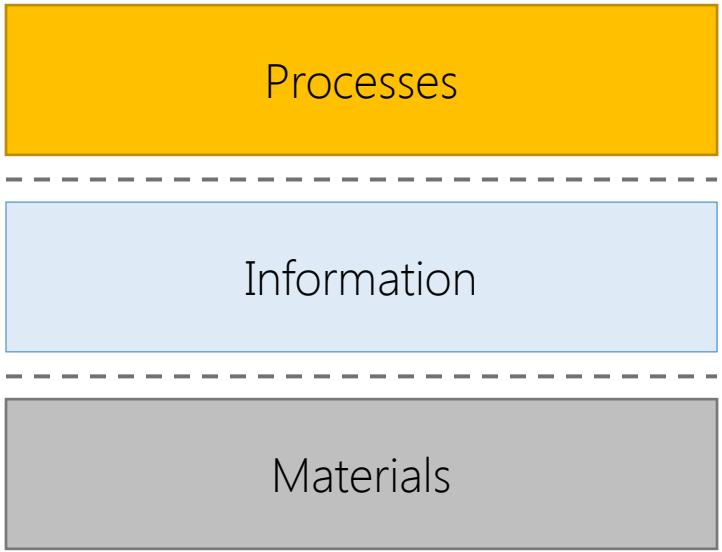
Semantic Models

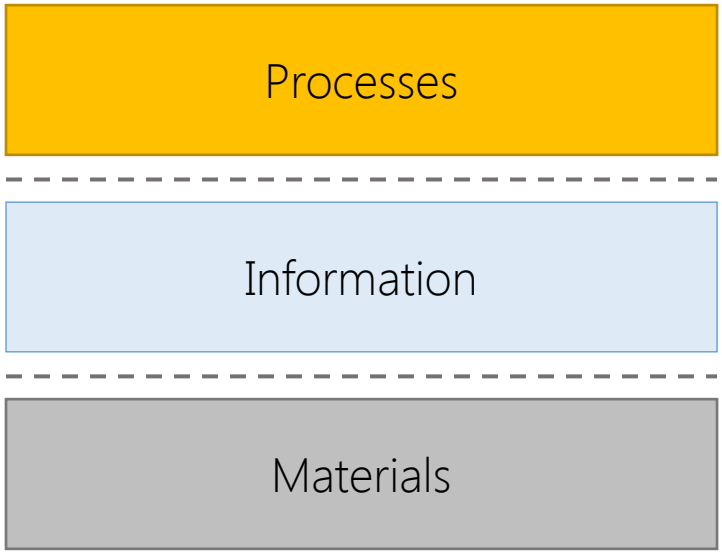


Semantic Model Features - 1



- Object oriented
- Bring together multiple worlds
  - Physical (Real)
  - Cyber (Digital)
  - Biological (Human/Cognitive)
  - …

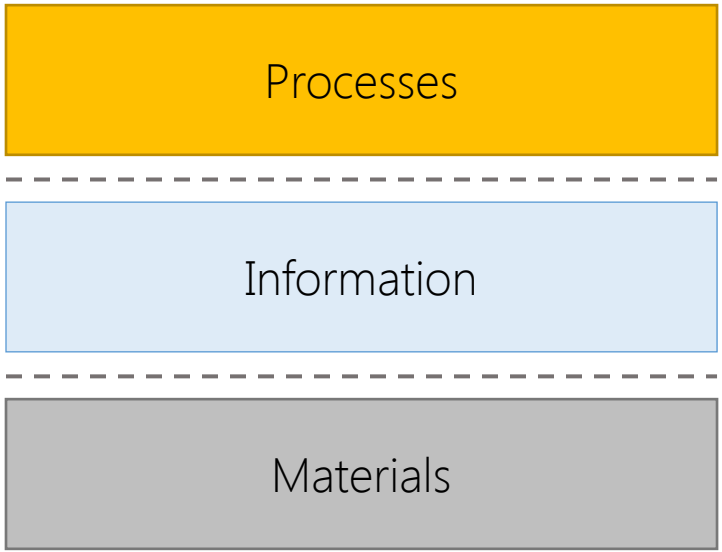
Semantic Model Features - 2



- Multi-faceted
- Different models for different user groups, e.g.:
  - Engineers
  - Finance
  - Risk Management
  - …

Semantic Web

Semantic Model Features - 3



- Formal languages
  - Machine processible
- Wide range of management tools
  - Editing
  - Debugging
  - Integration
  - Querying
  - Browsing
- International standards

Semantic Model Features - 3

- Formal languages
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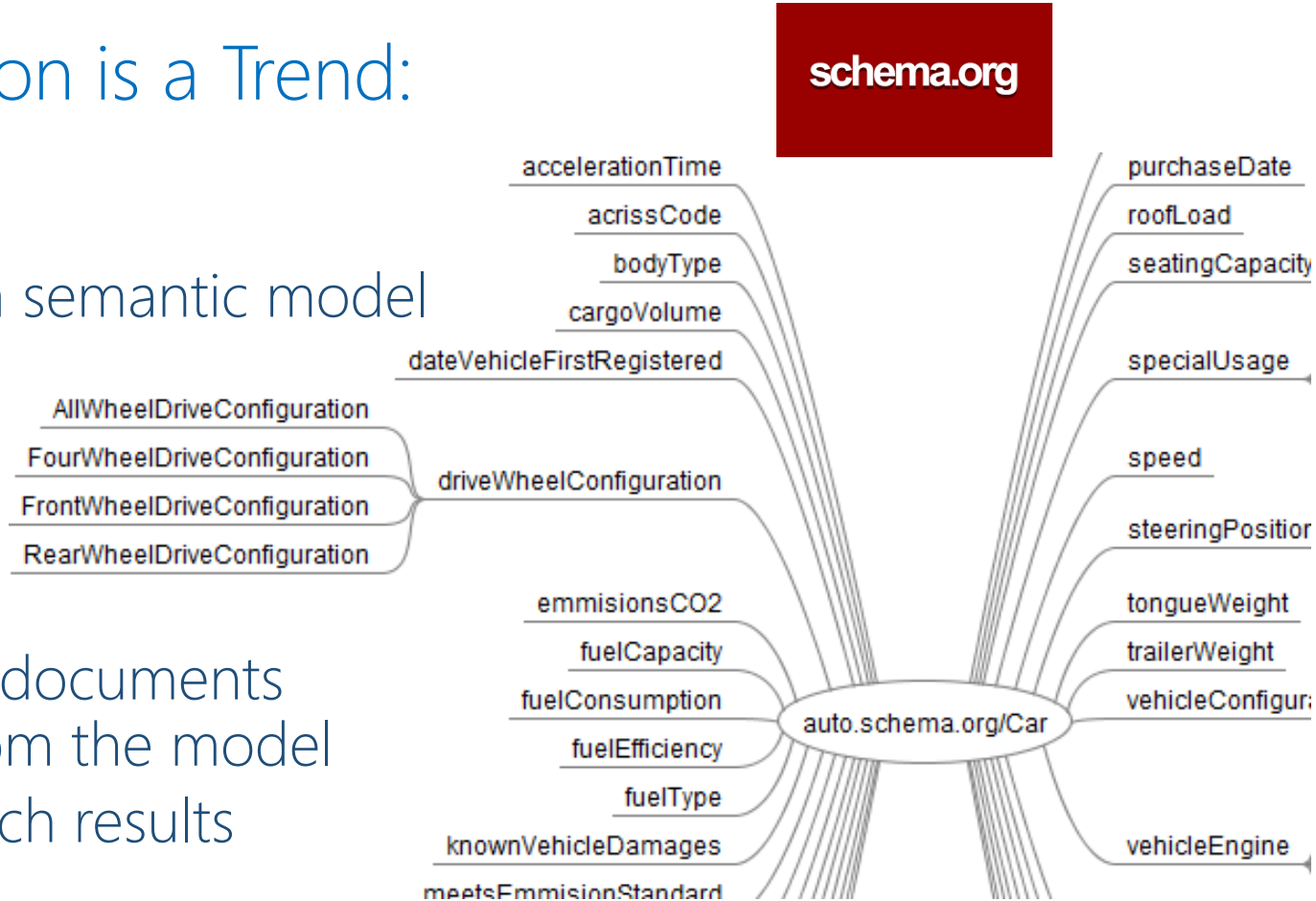
Semantification is a Trend: Examples

Schema.org: is a semantic model



- annotate your documents with classes from the model
- get better search results

Google

borsch

All Images Maps Videos News More Settings Tools

About 2,260,000 results (0.53 seconds)

Classic Ukrainian Borsch Recipe - Красный Борщ - Natasha's Kitchen

https://natashaskitchen.com/classic-russian-borscht-recipe/

★★★★★ Rating: 4.8 - 115 votes - 2 hr

Sep 26, 2010 - After several requests for my borscht recipe, here it is. Ukrainian Borscht… everyone knows what it is and many people enjoy it; Ukrainian or not. ... If you are pressed for time, shave off 1 hour by using canned beets with their juice.

How to Cook Borsch - Russian Recipe for Borshch - Master Russian

masterrussian.com/russianrecipes/borsch.htm

Borsch is the famous soup in many Russian families, as well as many Eastern and Central European countries. The recipes of **borsch** vary, but vegetables ...

meetsEmmisionStandard

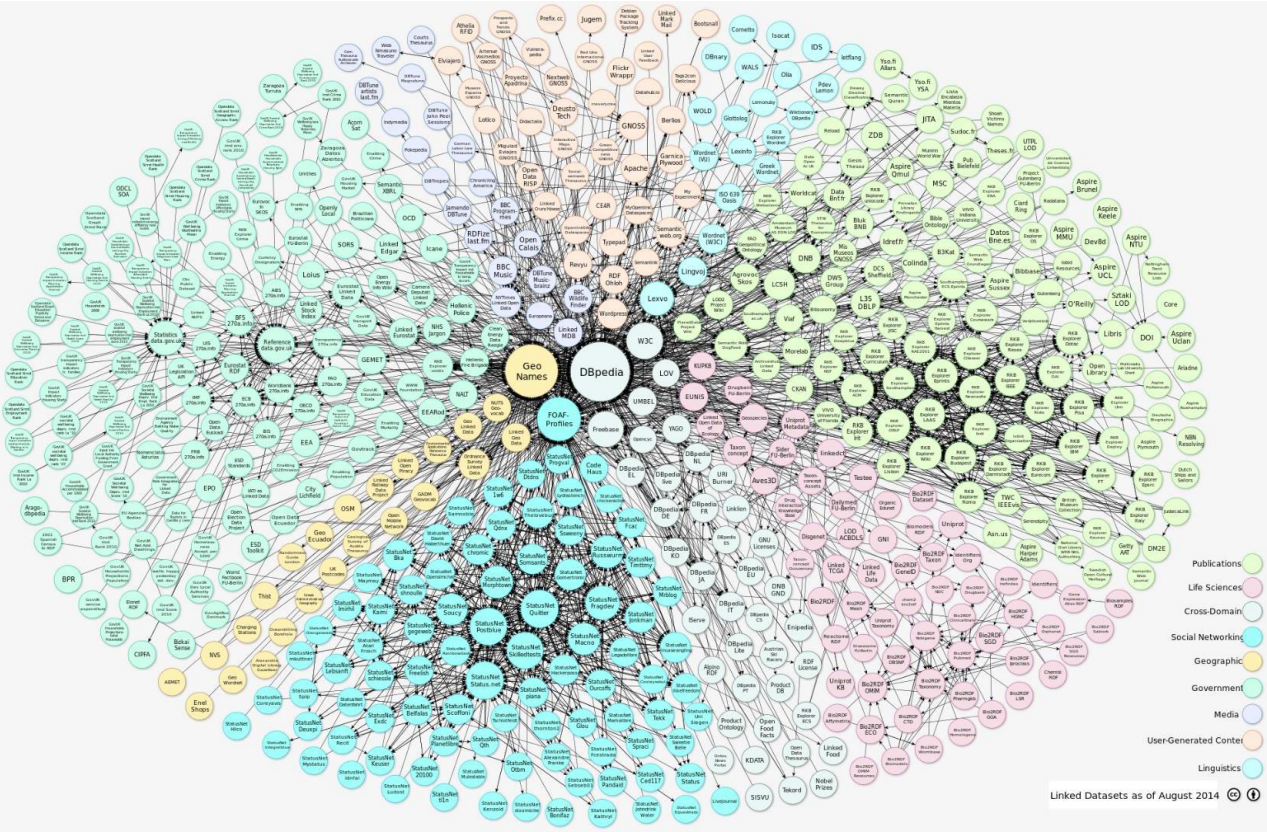
Semantification is a Trend: Examples

Google Knowledge Graph

knows Thomas Jefferson

- that he is a person
- it knows information about him
- it knows relevant people

Semantification is a Trend

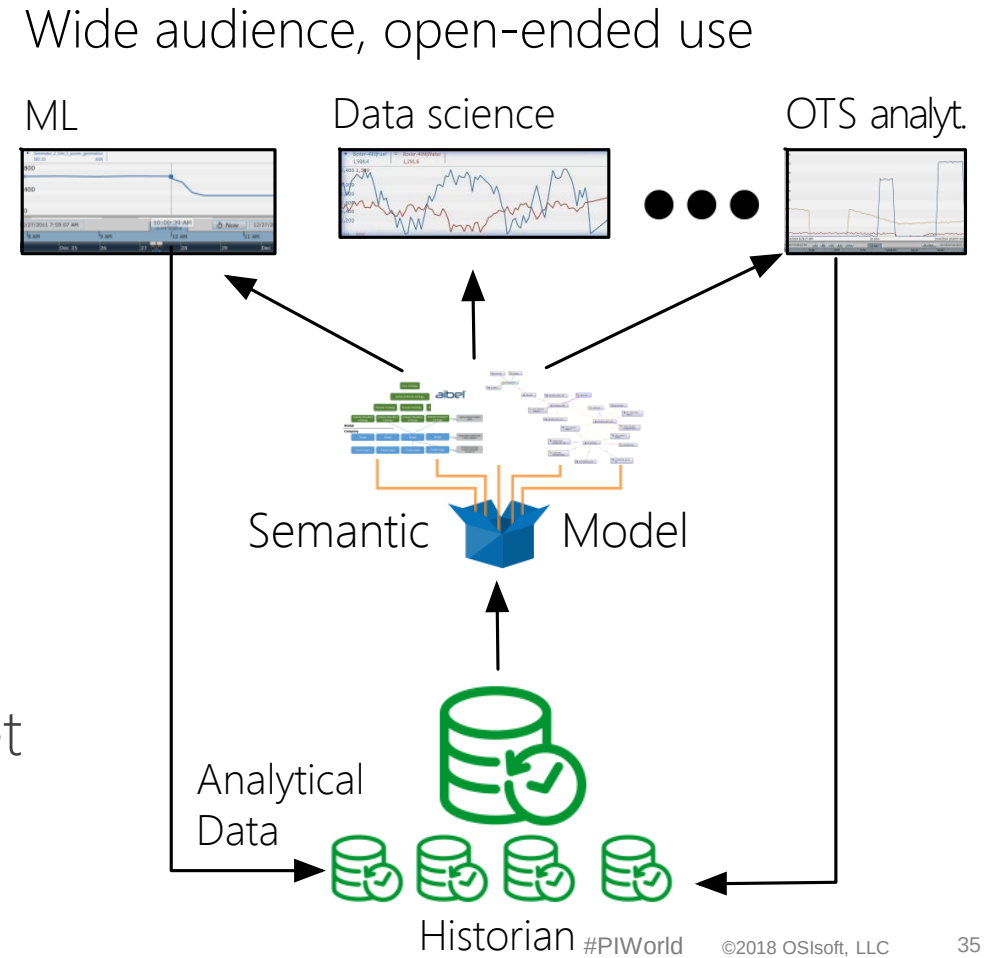


Linked
Open
(Semantic)
Data
Cloud

Semantic Digital Twins

Semantic models

- mediate data and applications
- are universal across users and applications
- already exist and can be offered via market places



Our Mid Term (Research) Goals

- Extend the PI System with semantic models
- Develop example ML tasks over semantic models
- Provide solid theoretical foundation for extensions
- Develop industrial use-cases and requirements
- Provide a demonstration with dashboards

Engaging With Us

SIRIUS' Digital Twin Strategy

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Questions?

Please wait for the **microphone**

State your **name & company**

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