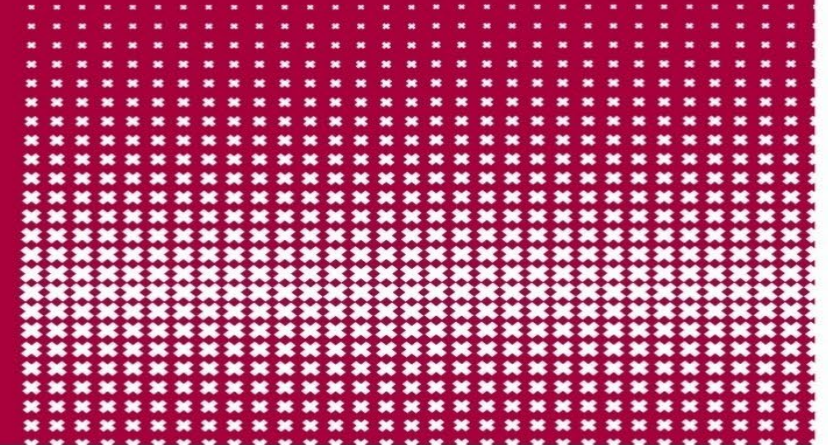




Faculteit Natuurkunde, Wiskunde en Informatica

Leibniz Institute



Normative Control over (Data Sharing) Infrastructures

Tom van Engers, L. Thomas van Binsbergen

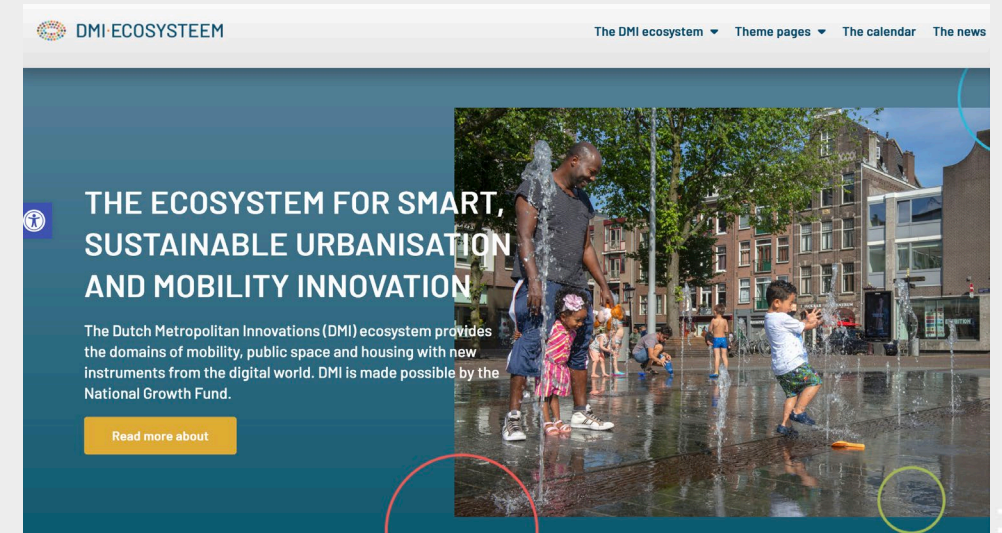
Working on (data-sharing) infrastructures

- Many platforms
- Mostly proprietary
- Many issues particularly
 - Trust
 - Governance
 - Normative (/Legal) Pluralism
- Technology developments is mainly focused on (semantic) interoperability ...



Example use cases

- Enabling Personalized Interventions (EPI)
- Secure Scalable Policy-enforced Distributed Data Processing (SSPDDP)
- Data Logistics for Logistics Data (DL4LD)
- Amsterdam Data Exchange (AMdEX)
- Data for Mobility Infrastructure (DMI)
- ...



What do these case have in common

- Constraint by norms from law, regulations and policies
- Highly Distributed eco system dependent on sensitive data and data processing (incl AI)
- Responsibilities and liabilities
- Legal pluralism (multiple laws and jurisdictions)
- Manual compliance checking (ex-ante and ex-post) can not deal with massive transactions
- Scaling problems

Huge costs come with compliance

- The OECD estimates that the cost of complying with regulations in international trade is equivalent to a tariff of 25% - 75% depending on the industry
- High cost: 25% to 75% of value of goods
- For the largest part (50%) these costs are attributed to the heterogeneity and complex way regulations are written

Norms and normative reasoning

- Time consuming; Manual review of regulations and policies is time-consuming and labor-intensive
- Compliance activities consume significant resources, including personnel, legal fees, and audits
- Long history in building LKBSs
- KR; Regulatory language is complex and open to interpretation, leading to inconsistencies
- We developed eFlint a DSL specifically aimed at describing interpretations of norms

Norm engineering for data spaces

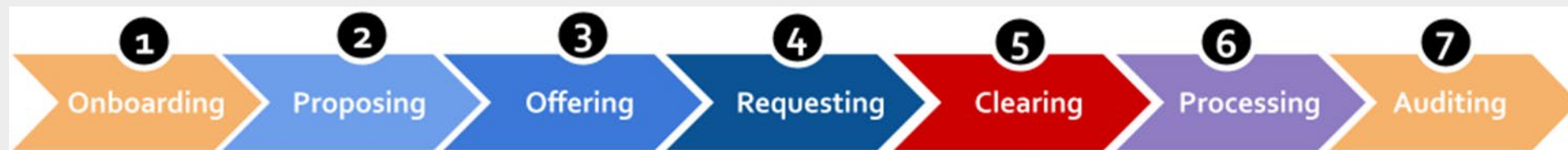
- Norm engineering pipeline:

law, regulation, contract → formal interpretation (software code)

- Digital enforceable contract pipeline:

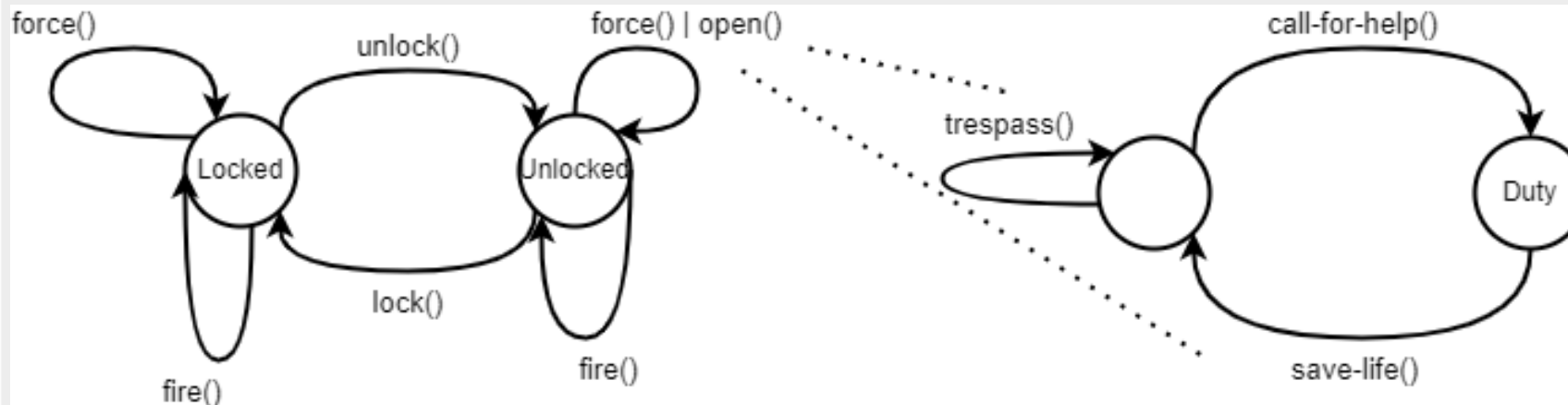
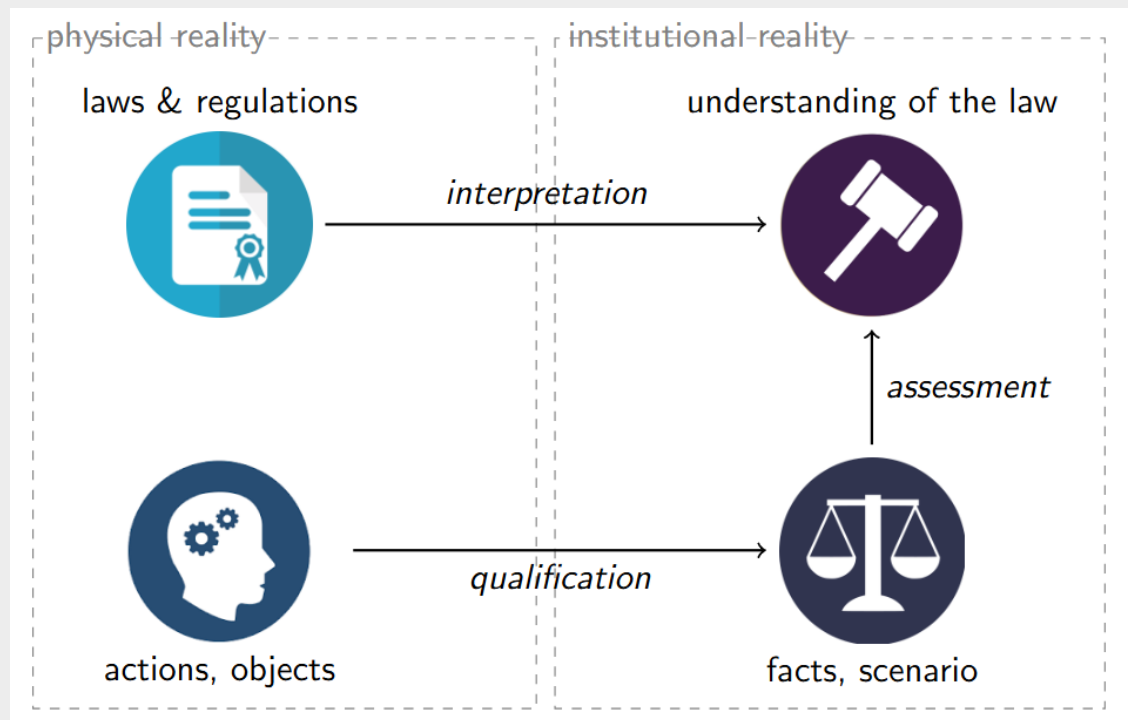
template(contract x formal interpr.) → legal and executable contract

- Integration in AMdEX governance flow ([AMdEX Reference Architecture v1](#))



Machine-readable vs Machine-executable

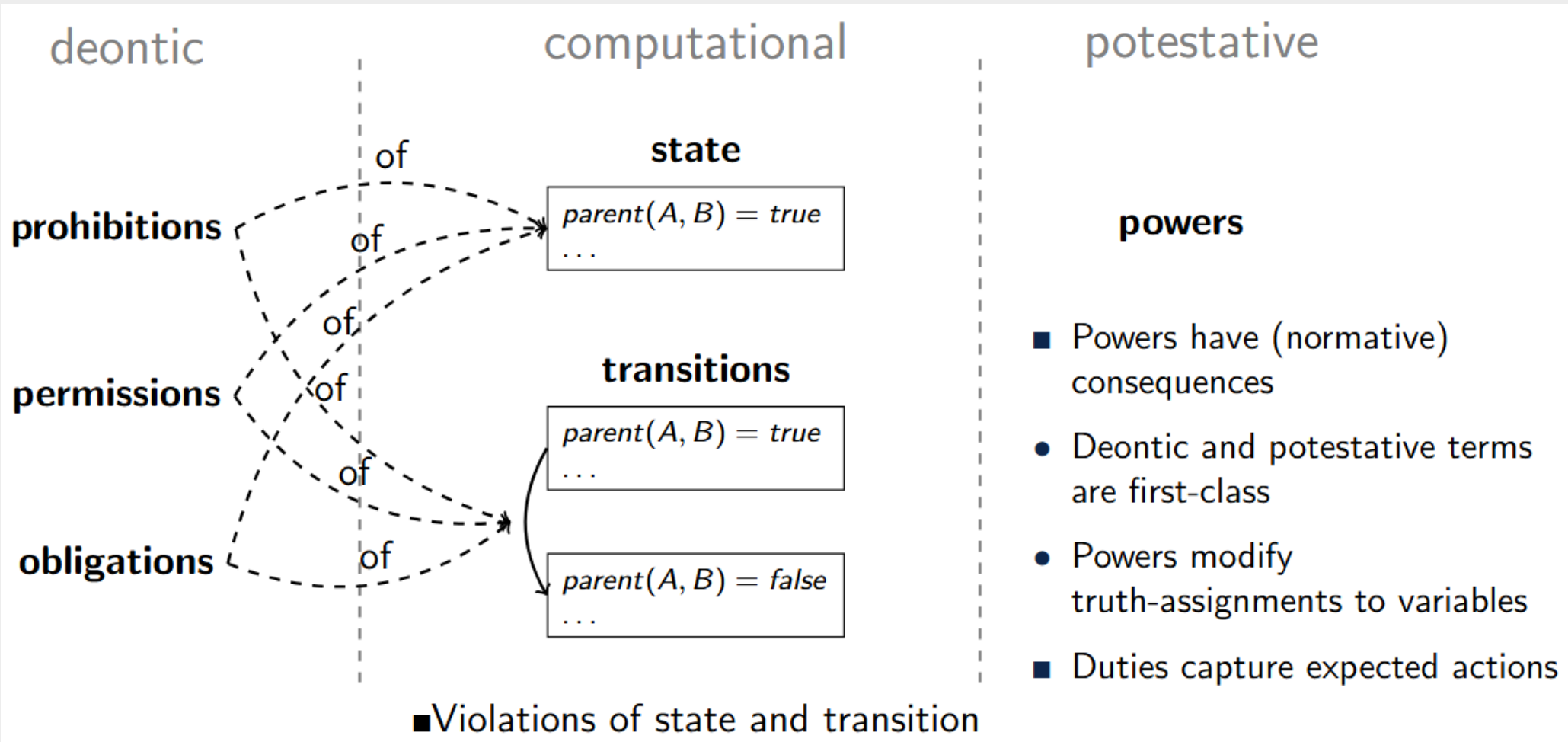
- Assessing individual **scenarios**
- Verifying system-wide **properties**
- **Simulation** and model-driven eng.
→ compliance by design



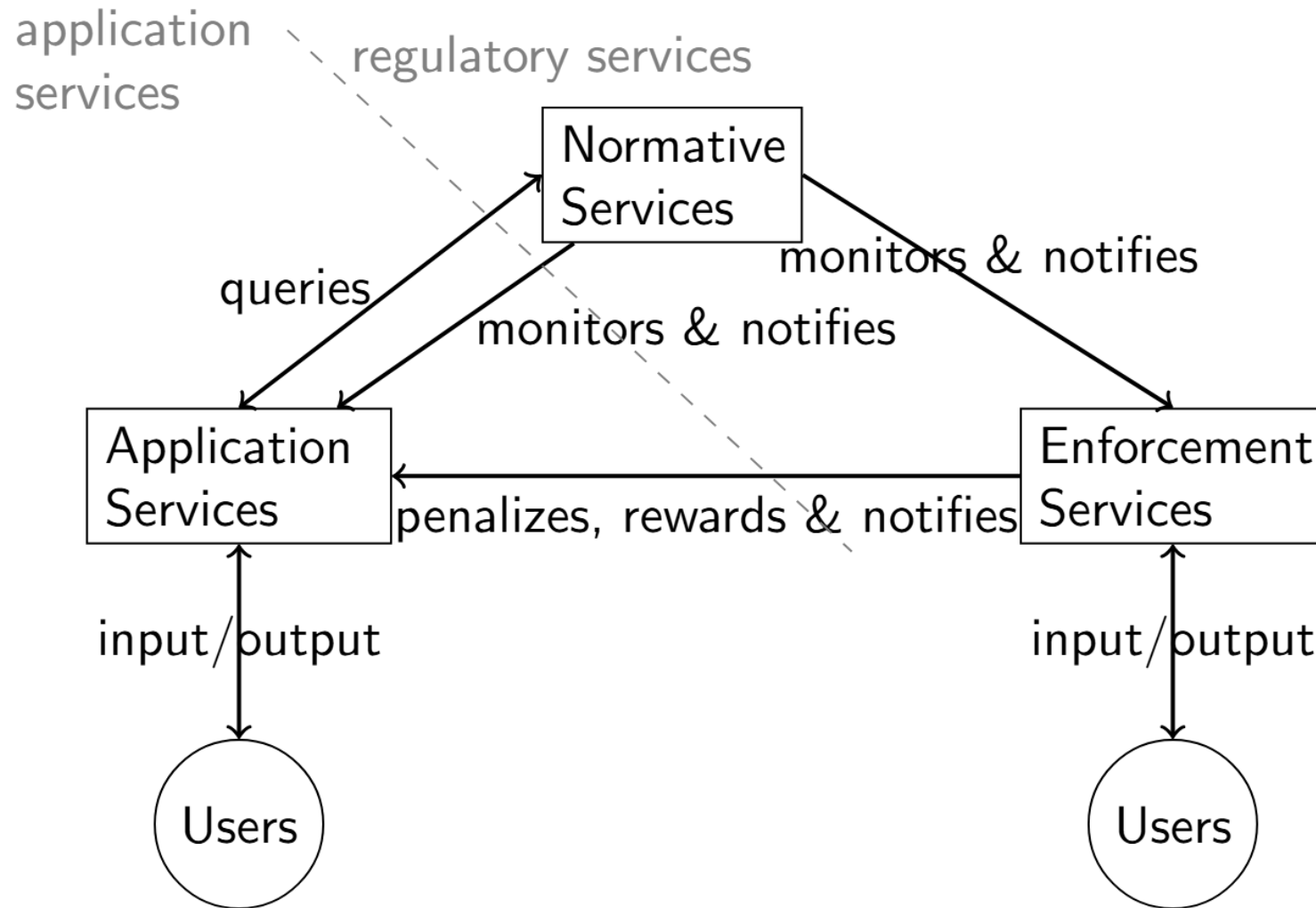
“A fireman is trespassing when forcing a door if there is no fire or call for help”

<https://doi.org/10.1145/3410256>

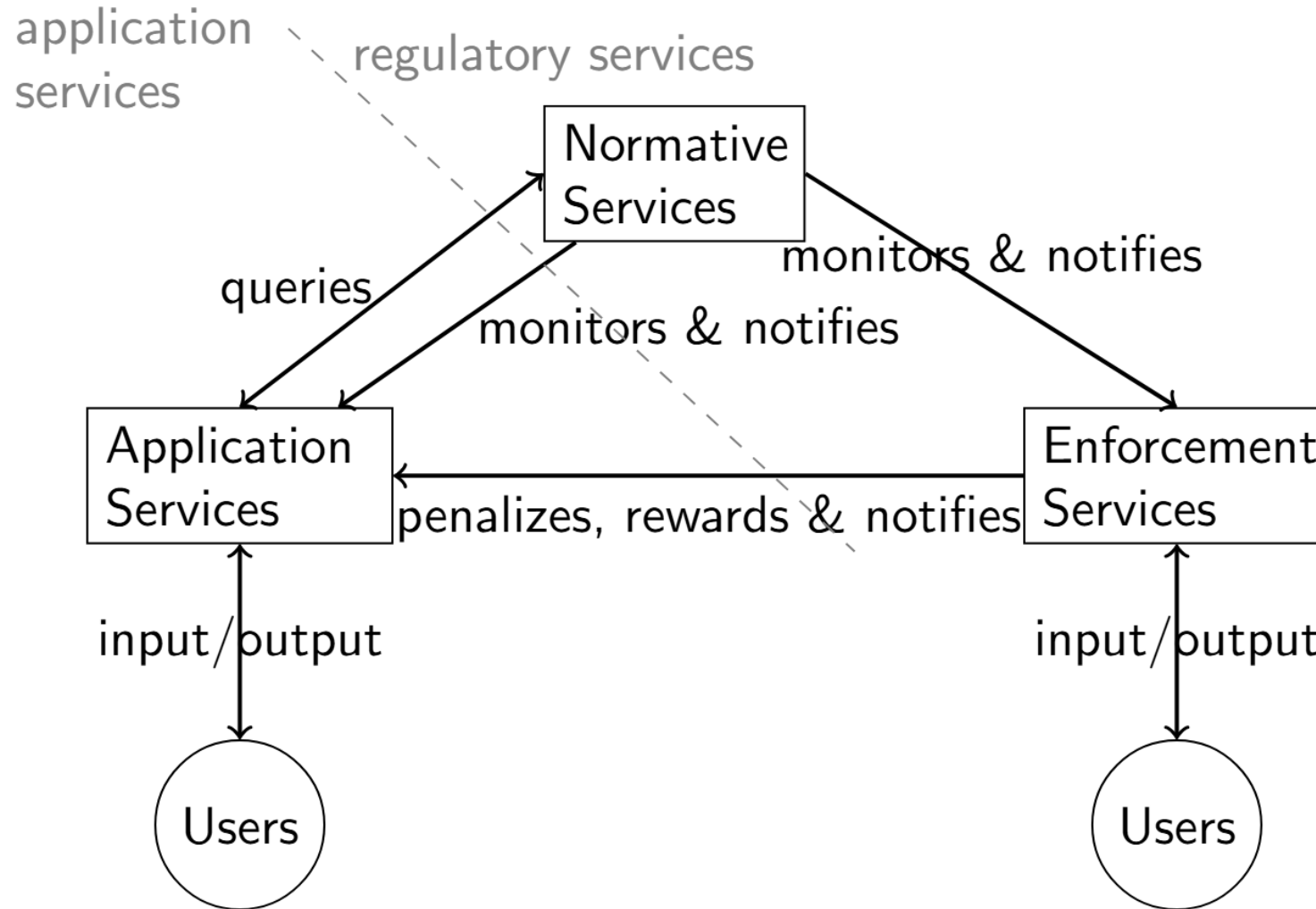
Linking normative and computational concepts



Data sharing systems as instance of regulated systems



Data sharing systems as instance of regulated systems

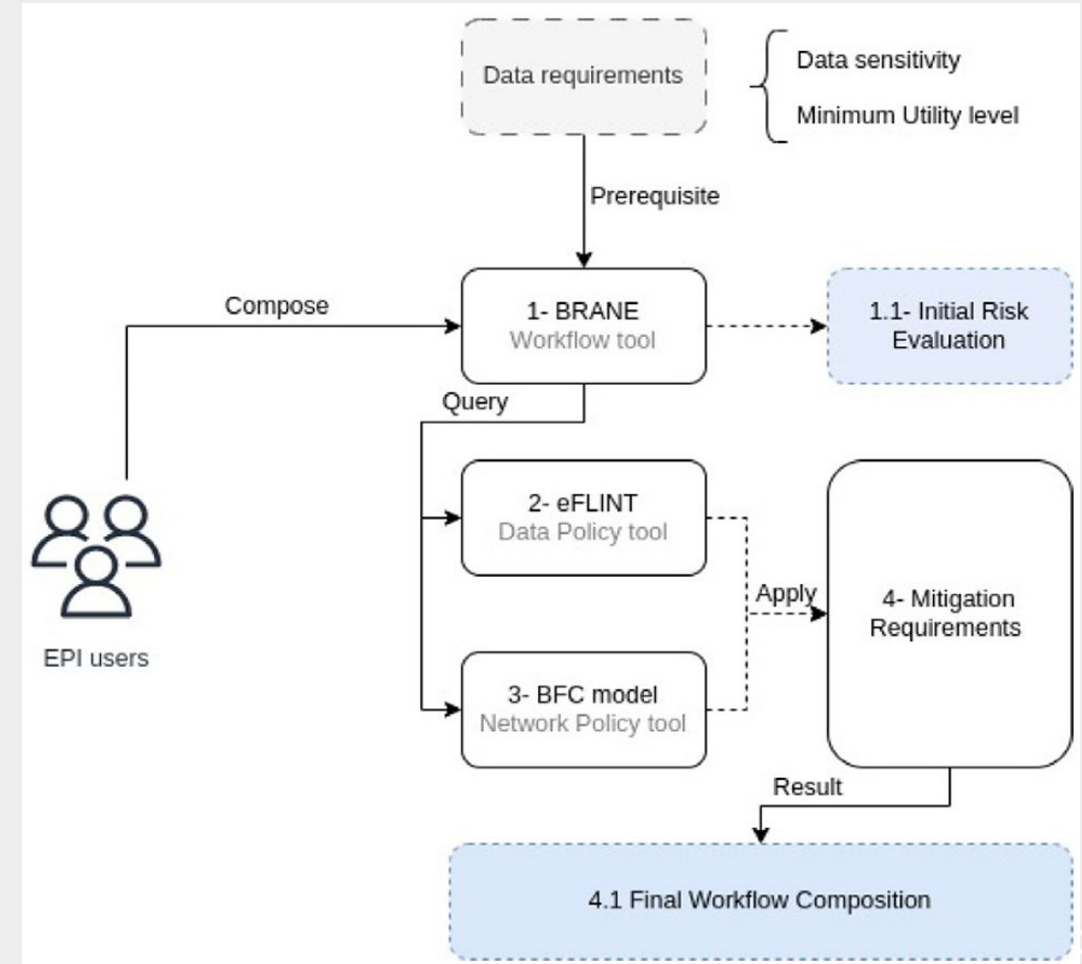


Enforcement strategies:

- **Static ex-ante;**
MDE, orchestration, planning
- **Dynamic ex-ante;**
Access control
- **Dynamic ex-post;**
Usage control, runtime verification, adaptations
- **Static ex-post;**
Accountability and Auditing

Static ex-ante enforcement

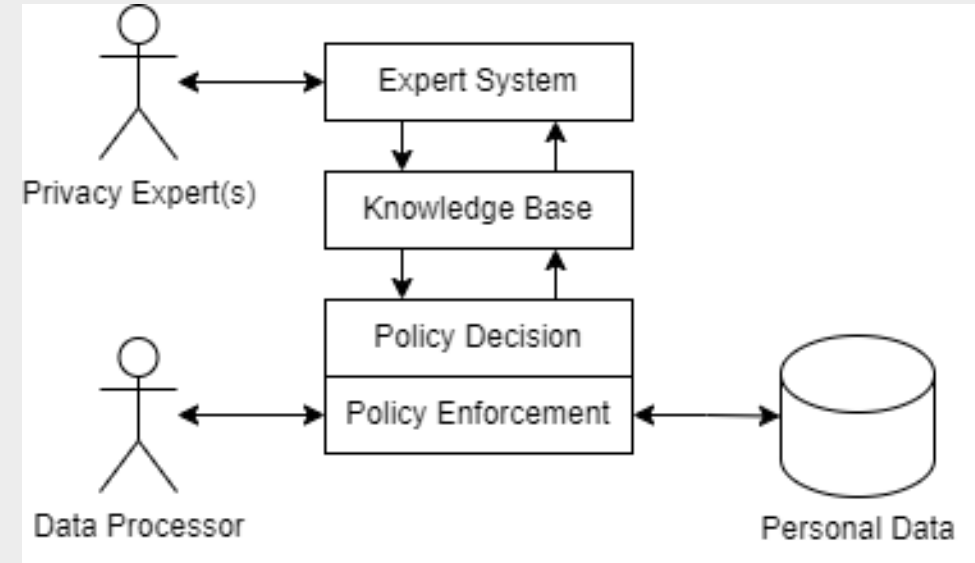
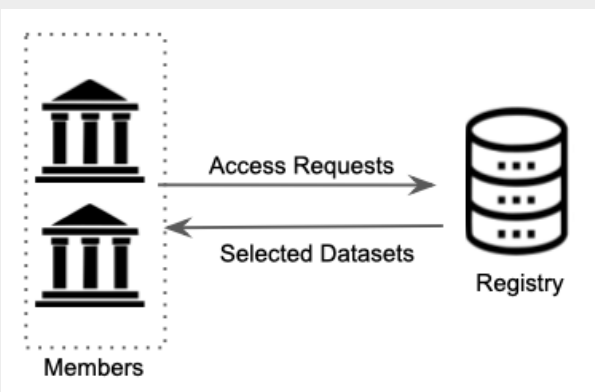
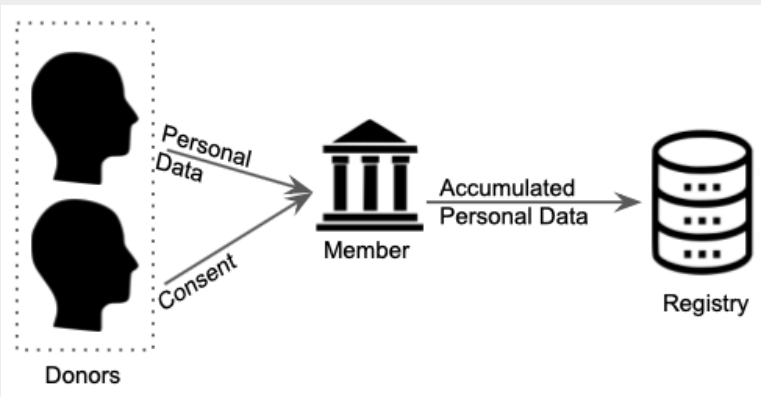
- Orchestration of workflow and middleware based on policy
- Conformance-checking of system model against normative model
- Simulation and model-checking of normative model behaviour



Dynamic ex-ante enforcement

Dynamic generation of **access control** policies from social policies

<https://doi.org/10.1016/j.procs.2021.12.221>



Lawful and Accountable Personal Data Processing with **GDPR-based Access and Usage Control** in Distributed Systems

Based on **XACML** architecture

Dynamic ex-post enforcement

Regulatory Services to Automate Compliance with Ex-post Enforcement

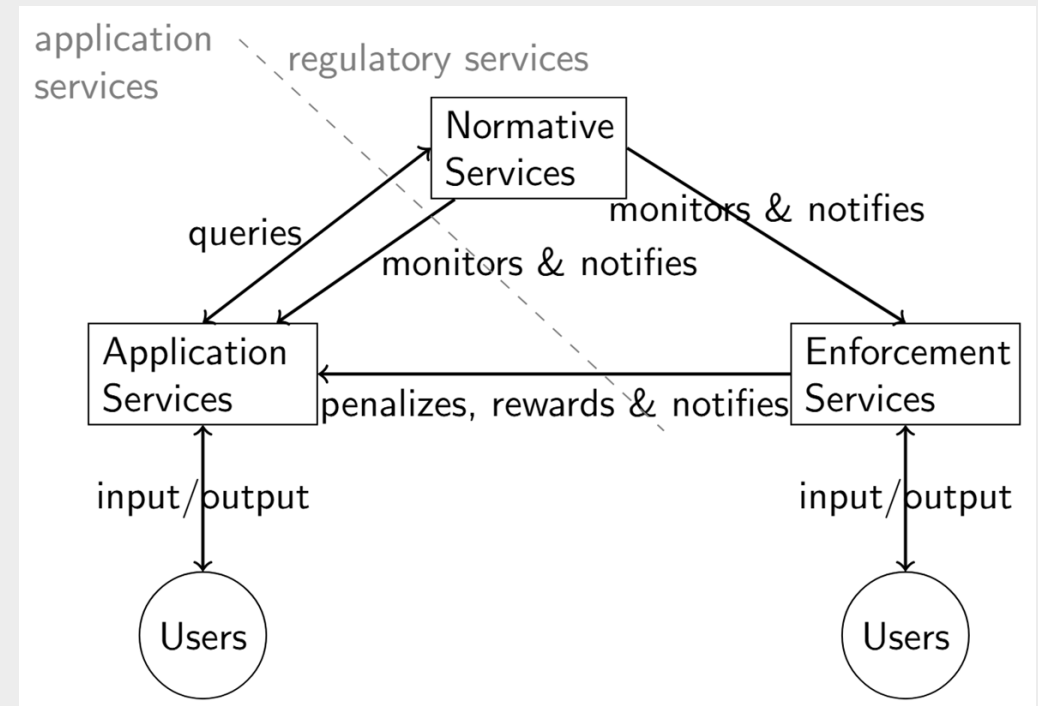
<https://ltvanbinsbergen.nl/files/papers/aicol-2023.pdf>

- **Explicit violations**

- Enforcement of **legal obligations**

based on **timed events** and (internal and external) **monitors**

human involvement to provide observations and judge violations

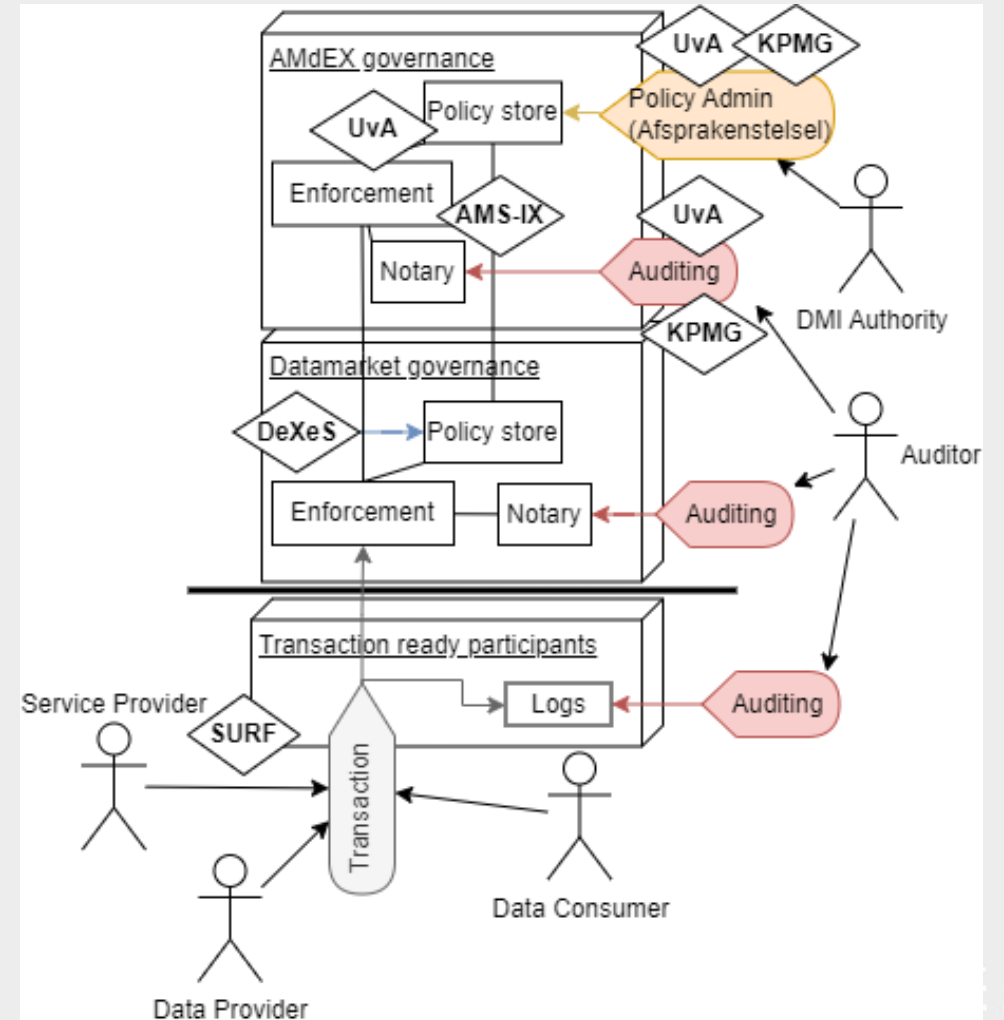


Static ex-post enforcement

- Access to logs and compliance decisions (accountability)
- Checking cases from logs for compliance (auditing)
- Partially automated construction of audit trails → audit report → trust ranking

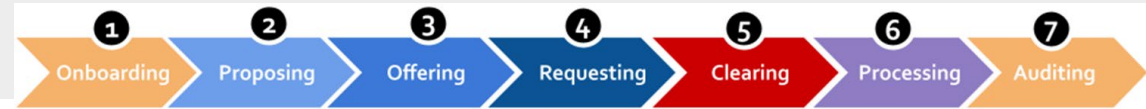













DMI ECOSYSTEM



Comparison to SIMPL requirements (EU commission)

<https://simpl-programme.ec.europa.eu/>



 <p>1. Dataspace setup: Role of governance authority</p>	 <p>2. Setup of ID/Trust, catalogues and vocabulary</p>	 <p>3a. Onboarding of providers & consumers</p>
 <p>3b. Onboarding of end users</p>	 <p>5. Provider adds a new resource to the catalogue</p>	 <p>6. Consumer searches resources on catalogues</p>
 <p>7. Consumer establishes a contract with resource provider</p>	 <p>8. Consumer uses an infrastructure resource from provider</p>	 <p>9. Consumer uses applications or data resources from provider</p>
 <p>12. Management/ operations of dataspace business</p>	 <p>13. IT administration</p>	

- + Logging for audits
- + Usage conditions
- + Contract templating
- + Machine-readable
- + Recording contracts
- + Service monitoring

- > Enforcement;
 - ex-ante, ex-post
- > Legal obligations
- > Power delegation
- > Human input re. violations, penalties
- > App. orchestration

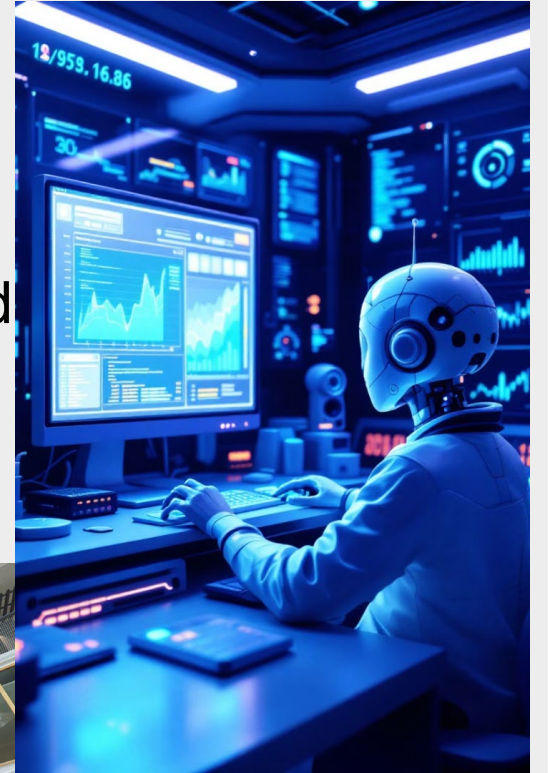
Conclusions

We showed you solution ingredients that allow the stakeholders in / users of complex infrastructures to:

- Set up collaborations in such way that they can protect their interests (following their policies) and be compliant to applicable norms from law and regulations, contracts etc.
- Create infrastructures that guarantee sovereignty over their data assets (and limit their liabilities)
- Produces audit trails and event logs that provide evidence when needed

Future Step

- Creating a GenAI factory for the compliance solution pipeline;
 - Benefit from the productivity gain that GenAI may deliver and
 - Benefit from auditable and explainable reasoning (SymAI)
- Knowledge Exchange:
 - GAIA-X Automated Compliance WG
 - IDSA working groups



Questions?



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