Engaging Content
Engaging People

Queryable Provenance Metadata For GDPR Compliance

Harshvardhan J. Pandit, Declan O'Sullivan, Dave Lewis
ADAPT Centre - Trinity College Dublin - Dublin, Ireland
https://openscience.adaptcentre.ie/
pandith@tcd.ie | @coolharsh55

The ADAPT Centre is funded under the SFI Research Centres Programme (Grant 13/RC/2106) and is co-funded under the European Regional Development Fund.

Overview

1. GDPR ← what, why, who, where, when; guidance by regulatory authorities
2. GDPR Readiness Checklist by Ireland's DPC
3. Semantification of queries
4. Implementation & Demonstration
5. Related Work

General Data Protection Regulation

- Enforced from 25th May 2018
- Fines: 4% global turnover or 20 million whichever is higher
- Obligations and rights based on use of consent and legal basis
- Necessary documentation
- Impact Assessments
- Data Privacy Officer
- Rights for Data Subjects
- Distinction between Controllers and Processors
- Sharing with Named Third Parties
- Privacy Seals

GDPR Readiness Checklist

Effort by Ireland's Data Protection Commissioner

http://gdprandyou.ie/

website with guidelines & resources

"GDPR Readiness Checklist"

Structure & Layout

1. 13 pages
2. 63 questions
3. 9 sections

GDPR Readiness Checklist (pg.10)

→ category of questions

Personal data

	Question	Yes	No	Comments/ Remedial Action
Consent based data processing (Articles 7, 8 and 9 and further guidance available on GDPRandYou.ie)	Have you reviewed your organisation's mechanisms for collecting consent to ensure that it is freely given, specific, informed and that it is a clear indication that an individual has chosen to agree to the processing of their data by way of statement or a clear affirmative action?	✓		more information
	If personal data that you currently hold on the basis of consent does not meet the required standard under the GDPR, have you re-sought the individual's consent to ensure compliance with the GDPR?		✓	specifics
	Are procedures in place to demonstrate that an individual has consented to their data being processed?		✓	details
	Are procedures in place to allow an individual to withdraw their consent to the processing of their personal data?	✓		
Children's personal data (Article 8)	Where online services are provided to a child, are procedures in place to verify age and get consent of a parent/ legal guardian, where required?	✓		

Q

sub-Q

BINARY

Analysis

Consider each question a 'query' → our approach

Three categories of queries:

1. **Demonstrative** → demonstrate a process or an activity
2. **Evaluative** → evaluate a criteria
3. **Assistive** → cannot demonstrate or evaluate, therefore retrieve all relevant information that can assist in demonstrating or evaluation

} ideal

— real

Analysis - notes

identifiers

https://w3id.org/GDPRep/checklist-demo/notes

Article in GDPR

data involved

	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Identifcatino of Provenance Metadata and Formulating Compliance Queries based on GDPR-Readiness Guide provided by Ireland's Data Protection Commissioner													
2	ID	Category	Title	Comment	GDPR	type	To Implement?	Data	Data Comment	Model based?	Model Comment	Instance based?	Instance Comment?	Automate
3	G1	General	Categories of personal data and data subjects	List the categories of data subjects and personal data collected and retained e.g. current employee data; retired employee data; customer data (sales information); marketing database; CCTV footage.		demonstr	Y	personal data, data subjects	subclasses that have other subclasses can be considered as categories in this case	Y	this only needs information about the classes, not the instances	N	instances are difficult to aggregate into categories, and would need some abstract information to efficiently do so	Y
4	G2	General	Elements of personal data included within each data category	List each type of personal data included within each category of personal data e.g. name, address, banking details, purchasing history, online browsing history, video and images.		demonstr	Y	personal data	subclasses that do not have other subclasses can be considered by types within categories	Y	this only needs information about the classes, not the instances	N	instances are difficult to aggregate into categories, and would need some abstract information to efficiently do so	Y
5	G3	General	Source of the personal data	List the source(s) of the personal data e.g. collected directly from individuals; from third parties (if third party identify the data controller as this information will be necessary to meet obligations under Article 14).		demonstr	Y	personal data, steps that collect data, entities that provde data	can this be assessed on the model of the system or it requires instances?	Y	there could be fixed models where data is collected directly from data subjects or some data provider which can be shown through the abstract model	Y	instances can show who the actual data providers are, if they can change with time. Ideally, the change should be reflected in the model	Y
6	G4	General	Purposes for which personal data is processed	Within each category of personal data list the purposes for the data is collected and retained e.g. marketing, service enhancement, research, product development, systems integrity, HR matters, advertising.		demonstr	Y	results of G1, processes acting on data	get all plans that contain steps that act on the data, then aggregate them based on categories	Y	run this over the model only as it enquires about the state of the system and not about a particular instance	N	this CAN be run on instances for data subject specific queries, but this is not what the original query meant	Y
7	G5	General	Legal basis for each processing purpose (non-special categories of personal data)	For each purpose that personal data is processed, list the legal basis on which it is based e.g. consent, contract, legal obligation (Article 6).		demonstr	Y	results of G4, processes acting on data	get legal basis in steps within plans from G4	Y	legal basis does not change in instances, so query this on models	N	this CAN be run on instances for data subject specific queries, but this is not what the original query meant	Y
8	G6	General	Special categories of personal data	If special categories of personal data are collected and retained, set out details of the nature of the data e.g. health, genetic, biometric data.		demonstr	Y	special category personal data	subclasses under special category of personal data	Y	as with normal categories of data, this query only needs information about category, not specifics	N	instances are difficult to aggregate into categories, and would need some abstract information to efficiently do so	Y
9	G7	General	Legal basis for processing special categories of personal data	List the legal basis on which special categories of personal data are collected and retained e.g. explicit consent, legislative basis (Article 9).		demonstr	Y	results of G6, steps that collect data, steps that store data	get all steps that collect or store special categories of data, then retrieve their legal basis	Y	same as G5, this is information about the abstract model	N	this CAN be run on instances for data subject specific queries, but this is not what the original query meant	Y
10	G8	General	Retention period	For each category of personal data, list the period for which the data will be retained e.g. one month? one year? As a general rule data must be retained for no longer than is necessary for the purpose for which it was collected in the first place.			N	results of G1, steps that store data	this is interpretative based on how retention time is calculated; ideally, this will be a part of the consent or policy that feeds into the provenance graph					
11	G9	General	Action required to be GDPR compliant?	Identify actions that are required to ensure all personal data processing operations are GDPR compliant e.g. this may include deleting data where there is no further purpose for retention.			N		this is very vague and does not depend or does not directly involve provenance; unless a list of processes or plans can be linked to show 'actions' but these would still need to be combined with some form of documentation					
12	P1	PersonalData	Validity of Consent	Have you reviewed your organisation's mechanisms for collecting consent to ensure that it is freely given, specific, informed and that it is a clear indication that an individual has chosen to agree to the processing of their data by way of statement or a clear affirmative action?	7,8,9	assistive	Y	consent, steps that acquire consent	This cannot be directly evaluated because of conditions such as freely given, specific, etc. which are qualitative. But, the information about how the consent was collected can be presented to make an informed decision.	Y	identify steps that collect consent along with static data content such as privacy policy and T&C that are used along with the form/mechanism used to collect consent.	N	This is assuming that the instances follow the abstract model. So the mechanism that they used to collect consent is the same as that referenced in the abstract model. Therefore, this is already considered to be evaluated under the abstract model. However, this CAN be used to retrieve and evaluate the consent mechanism for a particualr data subject.	Y

type

can be implemented?

NOT IMPLEMENTED

SPARQL queries

① nearly arbitrary number
② based on questions in checklist

available here → https://w3id.org/GDPRep/checklist-demo/sparql-queries

- 33 SPARQL queries
- Ontologies
  - GDPRov → provenance ontology for GDPR extends PRO-O & P-Plan
  - GDPRtEXT → • GDPR as linked data resource
    • Vocabulary of terms/concepts

prefixes

```
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX dct: <http://purl.org/dc/terms/>
PREFIX gdprov: <http://purl.org/adaptcentre/openscience/ontologies/gdprov#>
PREFIX gdprtext: <http://purl.org/adaptcentre/openscience/ontologies/GDPRtEXT#>
PREFIX p-plan: <http://purl.org/net/p-plan#>
PREFIX prov: <http://www.w3.org/ns/prov#<
PREFIX this: <http://example.com/ontology/shoppingapp#>
```

this: ← non-existant

G5. legal basis for processing

```
SELECT DISTINCT ?process ?legal where {
  ?data a ?data_type .
  ?data_type rdfs:subClassOf gdprov:PersonalData .
  ?step a ?step_type .
  ?step_type rdfs:subClassOf gdprov:DataStep .
  ?step gdprov:usesData ?data .
  ?step gdprov:isPartOfProcess ?process .
  OPTIONAL { ?step gdprov:hasLegalBasis ?legal } .
  OPTIONAL {?process gdprov:hasLegalBasis ?legal . } .
} ORDER BY ?process
```

Implementation

proof of concept that compliance questions CAN be expressed as SPARQL queries

- proof-of-concept demonstration
- example use-case: online shopping service
- GDPRov & GDPRtEXT ontologies
- Protege (environment) → FACT++ (reasoner)
  - easy-to-use
  - checks common human errors
  - visual tool
  - integrates with reasoners
  - can execute SPARQL

1. define instances
2. add metadata
3. run reasoner

Demonstration

https://w3id.org/GDPRep/checklist-demo

- online demo for querying of 'readiness checklist' information
- aims
  - convert static document to interactive/automated environment
  - use semantic web to create a graph of information
- same layout and format as original document
- queries SPARQL endpoint on page load (browser)

original document was a spreadsheet

executes SPARQL on page refresh

Query G2: Personal Data in Data Category

category →

Elements of personal data included within each data category

List each type of personal data included within each category of personal data e.g. name, address, banking details, purchasing history, online browsing history, video and images. → category description

Query ID →

G2. Types of Personal Data

SPARQL

```
SELECT DISTINCT ?data ?type where {
  ?data a ?type .
  ?type rdfs:subClassOf gdprov:PersonalData .
  FILTER(regex(str(?data), "http://example.com/ontology/shoppingapp#")) .
} ORDER BY ?data ?type
```

RAW RESPONSE | TABLE | PIVOT TABLE | GOOGLE CHART

Search: Show 50 entries

Results

	data	type
1	this:AnonymisedUserProfile	gdprov:AnonymisedData
2	this:CustomerAddress	this:CustomerInfo
3	this:CustomerBankAC	gdprov:SensitiveData
4	this:CustomerCardDetails	gdprov:SensitiveData
5	this:CustomerContactNo	this:CustomerInfo
6	this:CustomerEmail	this:CustomerInfo
7	this:CustomerName	this:CustomerInfo

data category

type of data

Showing 1 to 7 of 7 entries

Invalid/Non-existant/Empty/Null Queries

not all questions from the GDPR Readiness Checklist could be interpreted into SPARQL queries

Retrospective Consent

If personal data that you currently hold on the basis of consent does not meet the required standard under the GDPR, have you re-sought the individual's consent to ensure compliance with the GDPR? → can be checked with additional data

Does not contain provenance metadata OR Is currently not implemented

total questions = 63
SPARQL queries = 33
not-implemented = DO-THE-MATH 63 - 33 = ~~20~~ 30 → that's a lot!

↓

this happened because not all queries were quantitative IR questions

Queries that provide information

Purpose Limitation

Is personal data only used for the purposes for which it was originally collected? → cannot be evaluated

A1. personal data purposes

```
SELECT DISTINCT ?data ?process WHERE {
  ?StepType rdfs:subClassOf gdprov:DataStep .
  ?step a ?StepType .
  ?DataType rdfs:subClassOf gdprov:PersonalData .
  ?data a ?DataType .
  ?step ?action ?data .
  ?step gdprov:isPartOfProcess ?process
} ORDER BY ?data ?process
```

} SPARQL query to retrieve relevant information

RAW RESPONSE | TABLE | PIVOT TABLE | GOOGLE CHART | Search: | Show 50 entries

	data	process
1	this:AnonymisedUserProfile	this:RemoveUserAccountProcess
2	this:CustomerAddress	this:AdGenProcess
3	this:CustomerAddress	this:HandleRightDataPortability
4	this:CustomerAddress	this:HandleSAR
5	this:CustomerAddress	this:NewUserSignUpProcess
6	this:CustomerAddress	this:OrderProcess

→ is used in → check given consent to evaluate whether this is valid

Assumptions and Limitations

not in scope
not the aim of the work
requires more data

1. Does not assess compliance

2. Depends on consent → as in, the modelling of consent and how to interpret it

3. Interpretation of results is not clear

pre-GDPR notion of consent was a confusion carnival

results are just tabular data, what to do with it?

SPARQL ASK QUERIES

(a) why haven't you done them?

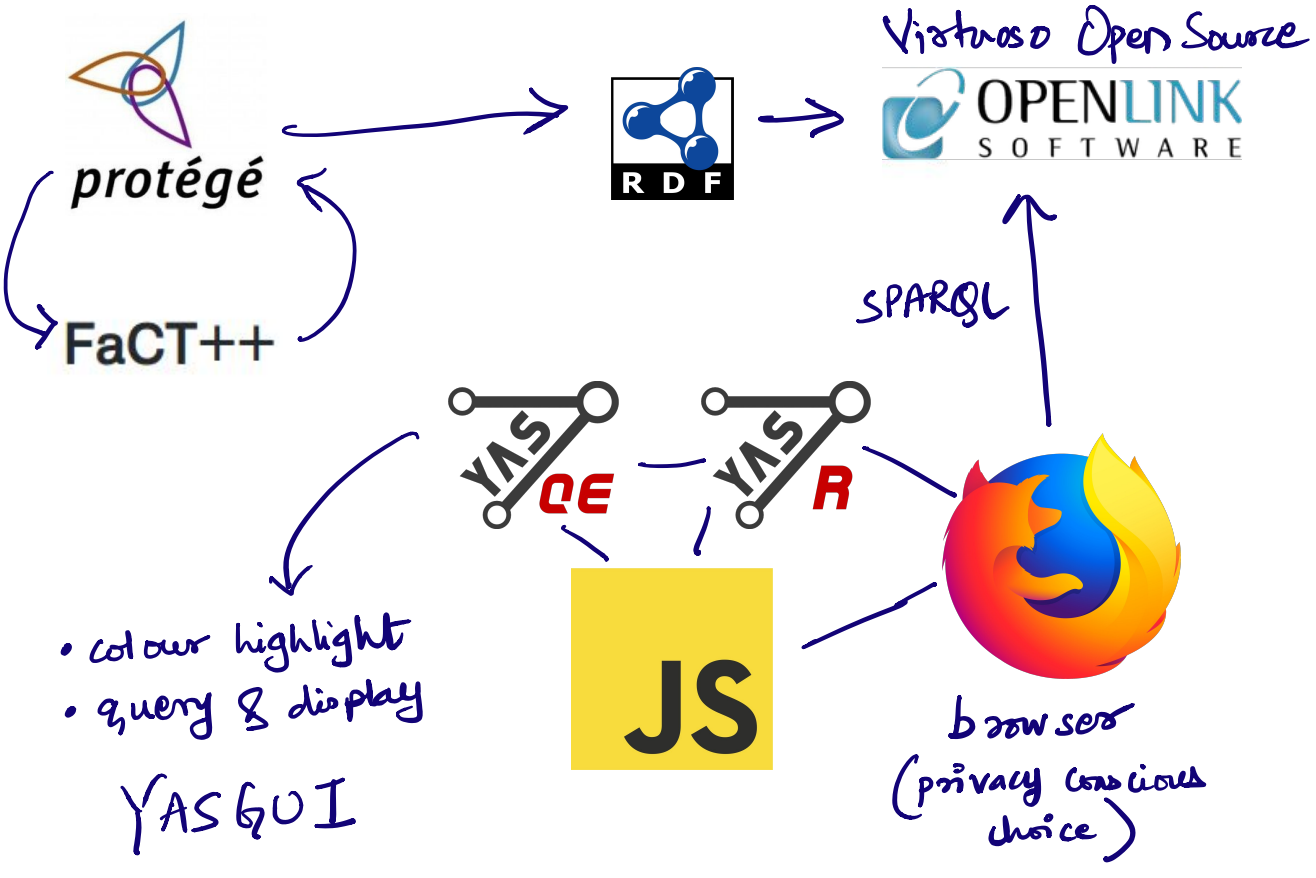
(b) Doing them now! Check out my POSTER

Proof of Concept!

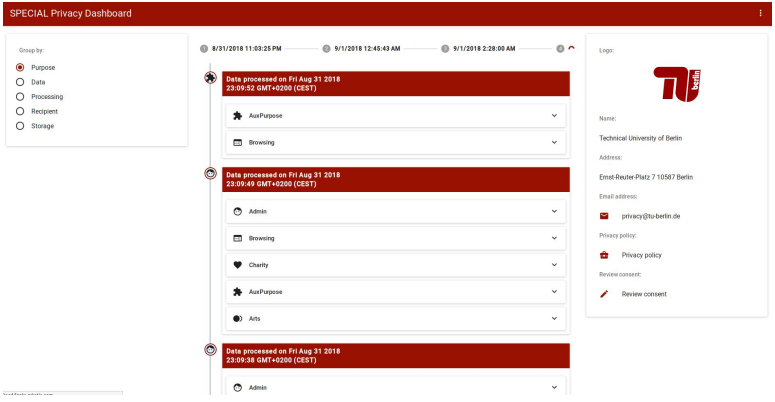
started out as an evaluation of how to express these compliance related questions as queries over semantic metadata

SUCCESS!!!

Technologies

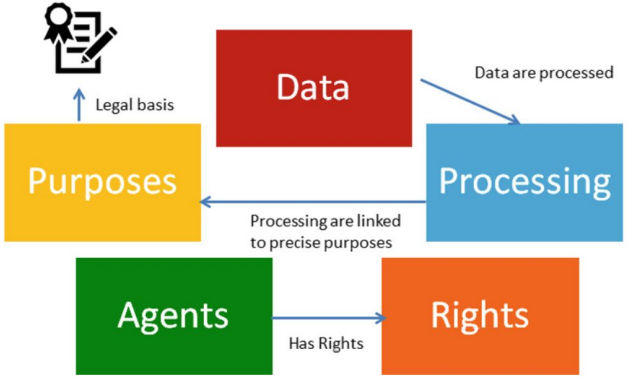


Keep your friends close, your 'peers' closer...



SPECIAL PROJECT

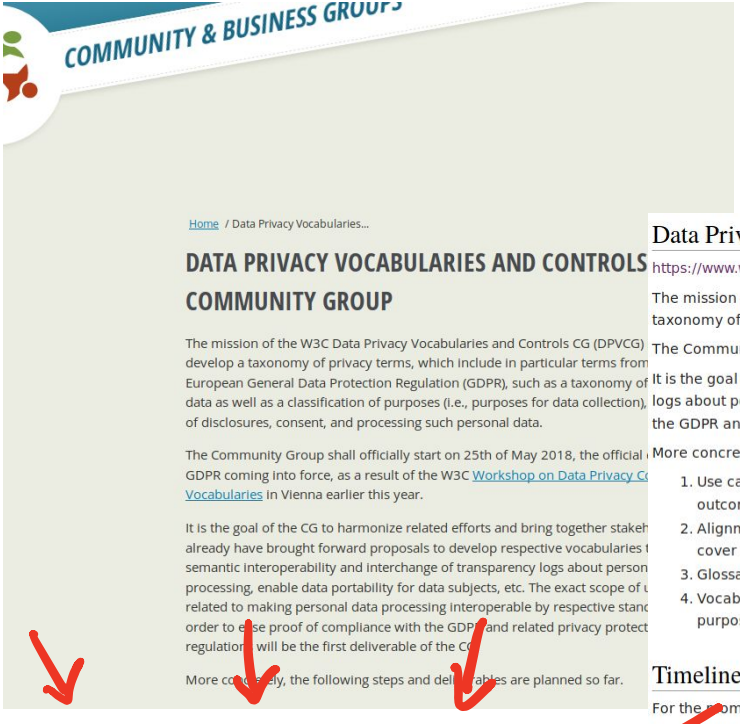
- Semantic web based compliance framework
- OWL reasoning to evaluate compliance
- Web-based dashboard

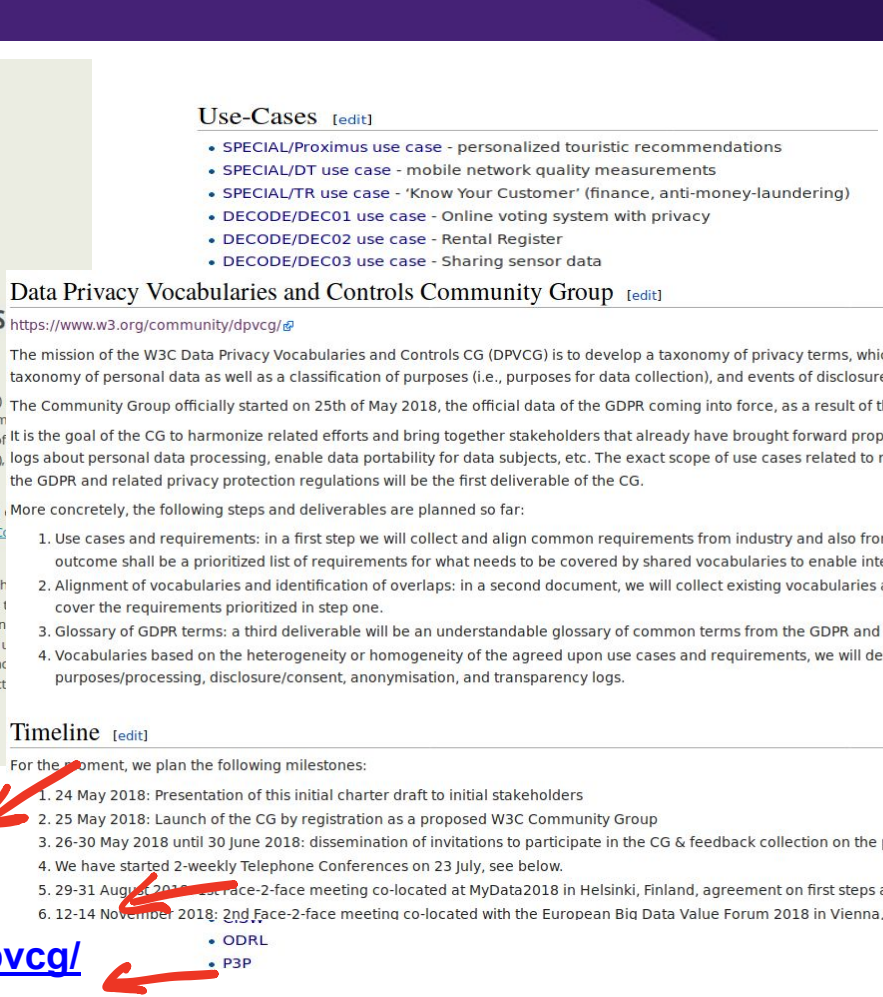


PrOnto Ontology

- OWL modelling of compliance related concepts and terms
- describe data (metadata) with relation to compliance

Join DPVCG





Data Privacy Vocabularies and Controls Community Group

https://www.w3.org/community/dpvcg/

Future Work

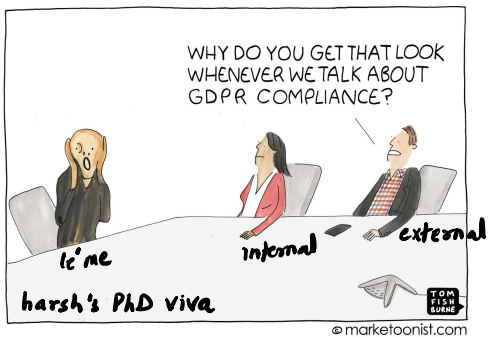
1. check GDPR compliance using SHACL → POSTER

2. build a 'knowledge graph' with compliance related information

Vision paper to be presented at ISWC workshop CKG

3. create a 'unit testing' approach towards compliance

test one thing,
but test it well



I'm a SPARQL endpoint, Query me!

www.adaptcentre.ie

How extensible is this approach?
very!

can GDPR compliance be checked in this automated manner
SOME OF IT

did a lawyer check this?
(I DON'T LIKE YOU!)

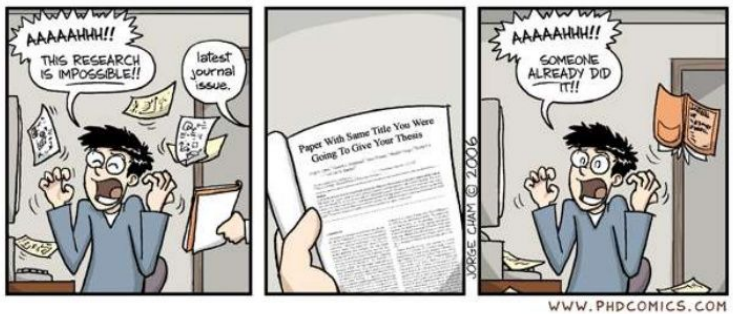
How do you define the metadata for the queries
JUST MODEL THE SYSTEM AS RDF

maybe you should use this approach....
OKAY....

what do you think about using non semantic web tools
NO THANKS

CAN WE COLLABORATE
YES ☺

is the demo *really* online?
Ja!



"**Queryable Provenance Metadata for GDPR Compliance**" at SEMANTiCS 2018
Presented by: Harshvardhan J. Pandit
http://openscience.adaptcentre.ie/ | pandith@tcd.ie | @coolharsh55