The Preservation and Sustainability of Research Data

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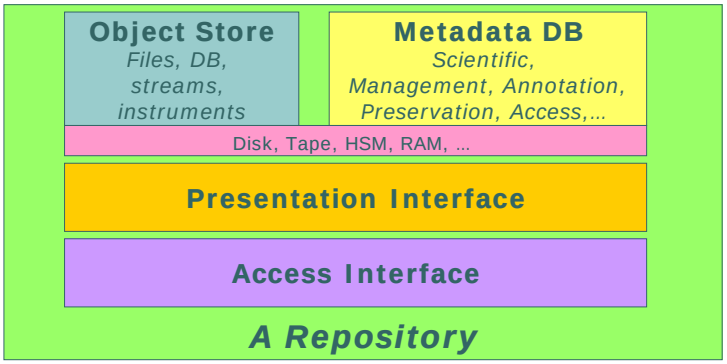
This talk is based in parts on the "AERES" survey and report for APSR with Paul McNamara

Research Data

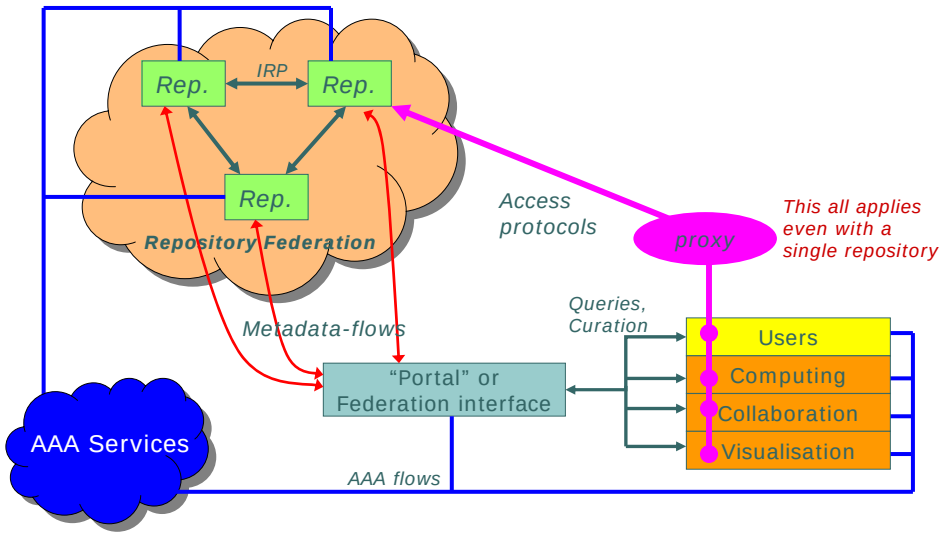
- This is not about publications but primary, derived or simulated data,
  - Which (may) lead to publication
  - Scholarly inputs and outputs
- Why is it different?
  - Data has a very different lifestyle
- Why is it hard?
  - Data has very different, and more complex, problems
- E-Research infrastructure?
  - Transparent and appropriate access to all resources,
  - to enhance research processes and build greater knowledge

We sort of **know** this…

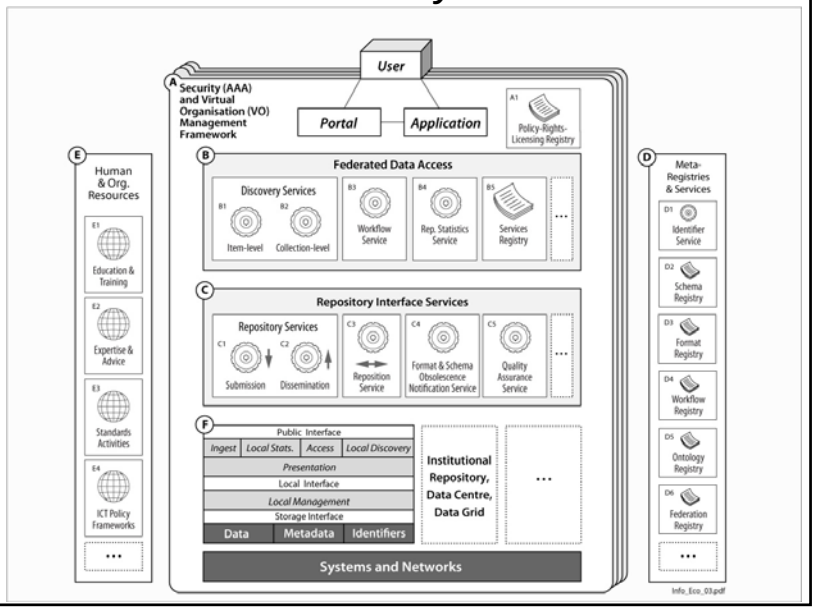


- **A (good) Repository**
  - is the sum of these things, and more…
    - Interfaces and services for management and curation, processes, security, standards, support, etc.

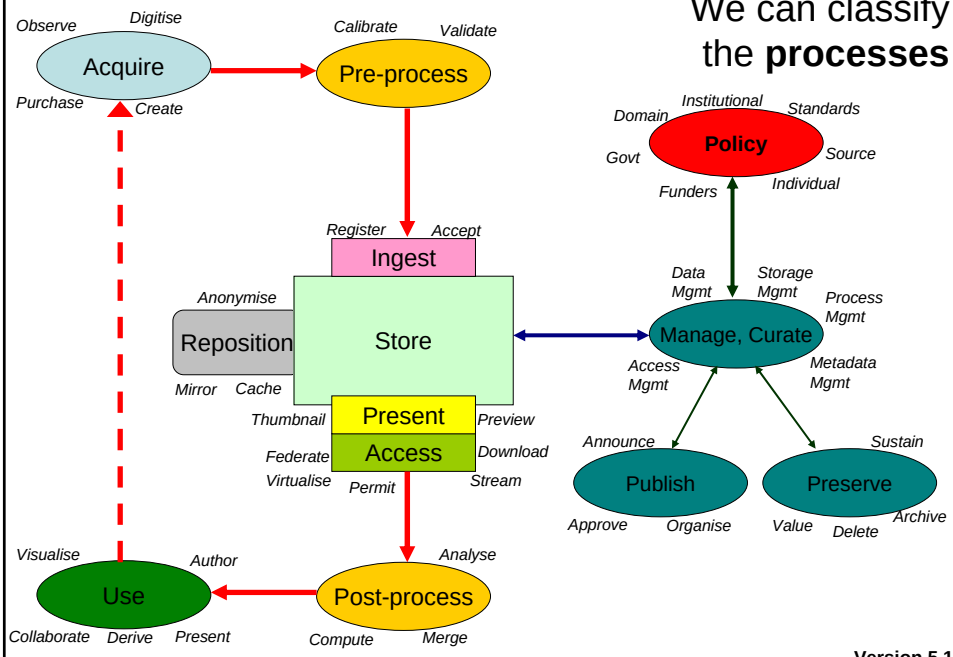
…and we can **architect** things around it…



…and we can identify the **services**



We can classify the **processes**



Version 5.1
Markus Buchhorn

Let's look at Application Areas

- Geosciences
  - Minerals, oils and gases, tectonics, Govt, Surveys, Industry
  - Many data sources (spatial and physical) and simulations
- Bioinformatics
  - Genomics, proteomics, …
  - Public datasets, private queries, private annotations
- Chemistry
  - Simulation, need data *services* mainly
- High Energy Physics
  - Large expensive instruments, projects
  - Massive data, computation and simulation

Application Areas - 2

- Earth Systems Sciences
  - Massive remote sensing data sets, large and complex simulations
- Astronomy
  - Big data, complex reduction process, big simulations, long-term research
- Financial
  - Many sources, Stock/Financial exchanges, news, …
  - Timeliness and also long time scales are both important
- Music, Arts, Sports
  - Performance, formal and practice
  - Education focus

Application Areas - 3

- Linguistics, Musicology
  - Archives of digitised cultural material
  - Complex analyses
- Social Science Data
  - Census, health, surveys, …
  - Complex data structures, qualitative data
- Archaeology
  - Digitised physical materials, spatial and chronological data

Consider just *some* Issues - Longevity

Geo, Bio, ESS, Astro, Ling, SS, Arch, Fin, Mus.

- Sustainability
  - Data formats
    - Descriptions, Compression, lifetimes
    - Simplex vs Complex (compound) objects
  - Software
    - Algorithms, implementations, OS
  - Versioning
    - Recalculation, interpretation, validation, derivatives
- Underlying infrastructure, technologies
  - Storage Facilities
  - Mirroring for protection – policy and technical issues

Issues- Metadata

Geo, Bio, ESS, Astro, Ling, SS, Arch, Fin, Mus.

- Varied research schemas
  - 1 is nice, but most have zero or five…
- Baseline DC is almost non-existent..
- Scientific description
  - Itself contentious…
- Provenance and processing
- Preservation, curation and valuation
- Subjective metadata, annotations

Issues - Rights

Geo, Bio, HEP, ESS, Astro, Ling, SS, Arch, Fin, Mus.

- Needs AAA to be working, to scale
  - Authentication, Authorisation and Accounting
  - Requires *identities* and *roles* to be understood
- Privacy, Security
  - Personal information leakage
  - Anonymised data, needs to stay usable
- Ownership
  - Not always (almost never!) with the researcher
- Time-varying
  - Data sourced under old agreements
  - Rights vary by status of source
    - people die, agreements expire, …

Movement

Geo, HEP, Ling, SS, Arch, Fin, Mus.

- Performance vs political requirements
  - *Mirroring/Caching; federated repositories*
- Collision with authorisation
  - *Some data cannot move from its host (in bulk)*
- Appropriate Delivery needs
  - *Remote/field access to data*
  - *Clients in a different 'circle'*
    - *Bandwidth, compute, language, culture*
- Movement Protocols
  - *Access protocols and inter-repository protocols*
  - *One standard is great – ten are not*
  - *Resource discovery, citation*

So why do this anyway?

- Create opportunities
  - For re-analysis, re-use; expected or otherwise
- Solve problems
  - Waste of $$, people and collection effort
  - Loss of irretrievable data
  - Inability to verify research
- Requirements (have to do it)
  - National good, cultural heritage, input to policy
  - Reference materials
    - Atlas, catalogues, …
    - Value not just in collection but in accessibility

Is it happening already?

- Data re-use/re-analysis
  - Ever more examples, some very good, some horror stories…
  - Policy conflicts
    - Data must be kept
    - Data must be deleted (anything involving people)
- But…
  - New culture
    - This data has value outside of my domain, or after my project?
  - New capabilities, provided by the Internet
    - Discovery of who has useful data
    - Accessibility of useful data
  - New (and old) fears by users (see later)
  - New data is easier to cope with than old data
    - Introduce new workflows and processes starting now
    - Recover old data as/when needed

Some of the players: Government and funders

- Strengths:
  - Control $$,
  - Control Policy
    - Define requirements, enforceability, and encouragement!
    - Set frameworks for ethics
      - Can of worms in its own right (c'tees getting involved in technical elements; too many c'tees at different layers, contradictory rulings)
  - Control some data (ABS, BoM, GA, RTA, AADC. …)
    - And can be data triggers (tobacco, regulators, …)

Government and funders

- Weaknesses:
  - Policy politely suggests publically-funded data should be well managed and accessible
    - No teeth
    - No infrastructure to back it up
    - No recognition of good effort
  - Funding is project oriented, infrastructure has to be systemic
    - One-off grant for lifetime support?

Government and funders

- Opportunities:
  - Effective policy, with $$ to back it up
  - Build a coordinated and sustainable infrastructure
  - Build skills, expertise
  - Save money
  - Increase research effectiveness
  - Increase leverage of investment

Government and funders

- Threats:
  - Loss of irretrievable data
  - Waste of $$ and effort in collecting the same data
  - Insufficient data for policy input
    - Environment, healthcare, education, security, …
  - Loss of research effectiveness
  - Other countries are doing this
    - UK, US, Asia (Taiwan, Korea, …)

Another key player: Organisations, Institutions

- Not just Universities
- Employ the staff that collect the data
- Manage the funds acquired by staff
- May have obligations,
  - Long-term (beyond staff tenure)
  - Moral and legal (is research data a ‘record’?)
  - Probably “own” the data
- Certainly have opportunities
- Have existing funding models
  - Shuffling between buckets…

And Users, who are *human*…

- Fear of missed "nuggets" in their data
  - Milk it for everything, for ever and ever
- Fear of missed errors
  - Probably varies by domain and career-stage
- Fear unknown custodians/stewards
  - Can't do as good a job as my PhD students
- Fear inappropriate leaks
  - Privacy/ethics,
  - first-to-market,
  - relationship to data providers (drug users, fishermen, …)
- Fear the cost of effort
  - Takes time (and money) away from what they're good at
- Fear lack of recognition
  - I've done it for the national good, how about some accolades?
- Fear of trusting somebody else's data
  - That person, or their repository may have done something wrong

Recognition

- "We" require data to be effectively deposited
  - But don't have anything to back up this requirement
- Implies an effective *place to* deposit
  - Recognition (certification) of repositories
    - How good, and how sustainable? What are the metrics?
- Implies an effective *process of* deposit
  - Recognition of the deposit effort
    - How well is it deposited? 1 star deposit into a 5 star repository?
  - Recognition of the deposit content
    - Depositor gets recognition, somewhat like a paper
      - Which requires a sufficiently good effort, and a citable repository
      - Interesting question of who "owns" the data, and hence accrues recognition
- Who carries out recognition, certification?
  - Domain-specific skills, technology-specific skills
  - Curation, preservation skills

Valuation

- What to keep?
  - Ideal model keeps everything, for ever
  - Pragmatism dictates some data deletion
    - Who has the right to make that decision,
    - and takes on the responsibility
      - Especially if later proven wrong
  - Cost is going down
    - Storage (physical media) is getting cheaper
    - Processes for management are starting to scale
      - Especially for the basic storage/access services
    - Keeping everything is becoming reasonable
    - Keeping it for ever is becoming manageable

Sustainability

- Follow the $$$
- Govt top-slice, or top-up to institution/user
  - Fund fewer people to do more things?
  - Fund the same number to do more with less?
  - Create a whole new funding stream?
- Institutional top-slice, or top-up
  - Same questions.
- Leave it to users/communities
  - Where there's a will, …
    - But we need to support areas where there isn't a will as well

Implementation

- Get users out of data management at some level
  - Scale costs on infrastructures, services and skills that are sufficiently common
- Deal with user fears
  - Some of it needs education, some of it needs trust to be established
    - E.g. Scalable AAA mechanisms are now coming along nicely
- Users provide domain specific skills and domain policies
  - Coordination role within a domain – required!
  - But need technical backing when it crosses some boundary

Implementation - 2

- All repositories don't need to do everything
  - Some can be more equal than others.
    - By domain, by technology, by fundamental services…
  - As long as the sum of the services exceeds the sum of needs
    - Most technical problems can be solved today.
    - Policy is the main hurdle.
- Achieving the goal
  - What are the carrots and sticks that actually work?
  - Who are best placed to wield them?
- Sustaining the goal
  - The answer is money, but what is the question?

Is anybody *thinking* about this?

- Universities and partnerships
  - APSR and other groups
- Federal and State Govt
  - DEST, PMSEIC, NCRIS (SII), eResearch-CC, Productivity Commission, …
- Funders and managers
  - ARC, NHMRC, AVCC
- Here's hoping…