UCLA Center for Knowledge Infrastructures

Data Management in the Long Tail: Social and Technical Opportunities

Christine L. Borgman, **Milena S. Golshan, Ashley E. Sands**, Jillian C. Wallis, Rebekah L. Cummings, Bernadette M. Randles

University of California, Los Angeles (UCLA)

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Research Project

- Conceptualizing an Institute for Empowering Long Tail Research (IELTR)

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Research Question

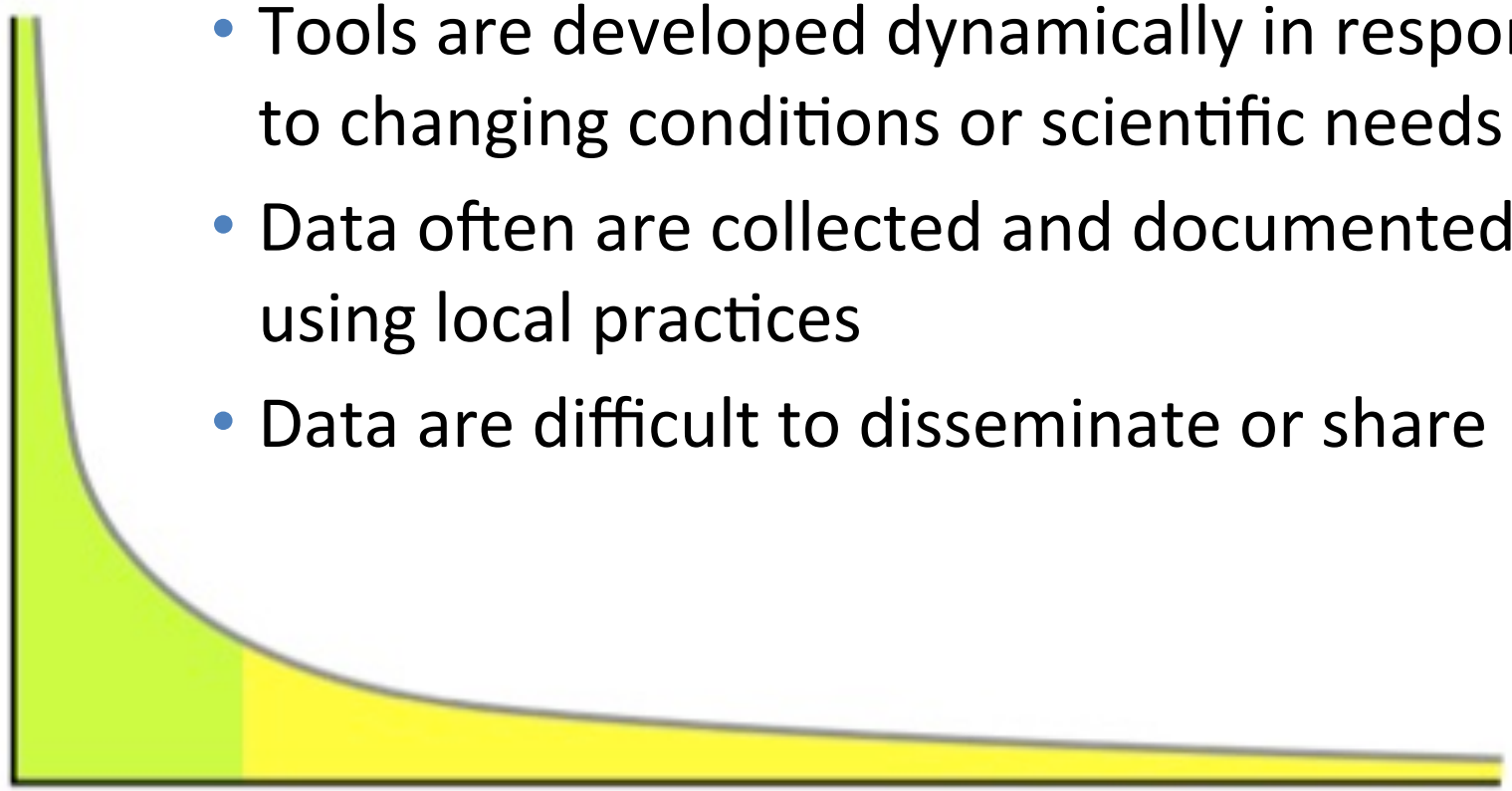
- Is Software as a Service (SaaS) a possible solution for long-tail science and more specifically, for small and medium-sized laboratories (SML)?

Software as a Service (SaaS)

- Applications are run in cloud environments
- Software packages are typically accessed via a web browser, with a subscription payment model
- A company provides software applications, maintains the applications, and usually provides technical support to users
- Familiar (non-scientific) SaaS: Google Drive, DropBox
- SaaS for science: Globus, Zotero

Long Tail of Science

- Small research teams
- Diverse data
- Tools are developed dynamically in response to changing conditions or scientific needs
- Data often are collected and documented using local practices
- Data are difficult to disseminate or share



Scales of Science

	Big Science	Little Science
Funding	Millions or billions (US$)	Thousands (US$)
Duration	Decade or longer	Months, up to a few years
Facilities	Large-scale	Laboratory equipment
Size of collaboration	Hundreds or thousands	Individuals, small teams
Bureaucratization	Extensive	Ad hoc recordkeeping
Division of labor	Highly-specialized	Little or none
Authorship practices	Corporate model	Single, handful of authors
Data	Large, homogeneous	Small, heterogeneous
Data practices	Standardized	Localized, ad hoc

Darch, P. T., & Sands, A. E. (2015). Beyond big or little science: Understanding data lifecycles in astronomy and the deep subseafloor biosphere. *iConference 2015*

Knowledge Infrastructures

- "…the promise of these technologies is predicated upon the availability of knowledge infrastructures, defined as **'robust networks of people, artifacts, and institutions that generate, share, and maintain specific knowledge about the human and natural worlds'** (P. N. Edwards, 2010, p. 17), in order to enable the production, management, curation, and accessibility of data" (Darch & Sands, 2014).

http://knowledgeinfrastructures.org

Research Methods

- Ethnography
  - Observing activities on-site or on-line
  - Embedded for days or months at a time
- Interviews
  - Questions based on our research themes
  - Compare multiple sites over time
- Document analysis
  - Public and private documents and artifacts
  - Official and unofficial versions of scientific practice

Research Sites

- Center for Embedded Networked Sensing (CENS)
- **Center for Dark Energy Biosphere Investigations (C-DEBI)**
- IELTR Workshop for Natural Reserve Sites

C-DEBI

- Center for Dark Energy Biosphere Investigations (C-DEBI)
  - Overall goal: to create a community of researchers to study subseafloor microbial life and the interactions between this life and the physical environment
  - Our team performed two years (2012-2014) of ethnographic participant observation and 49 interviews on data practices at C-DEBI

Center for Dark Energy Biosphere Investigations

International Ocean Discovery Program
Iodp.tamu.org

Repository for seafloor cores. Photo: Peter Darch

- NSF Science & Technology Center, 2010-2020
- 20 universities, plus partners (35 institutions)
- 90 scientists
- Biological sciences
- Physical sciences

C-DEBI: Data Management Challenges

- Vast variety of data
- Variety of tools with incompatible software
- Lack of common metadata standards
- Lack of resources and no designated IT staff
- Lack of software expertise
- Need for a centralized system to hold data in one place

C-DEBI: Data Specifics & Data Needs

- Data collection: based on extraction and analysis of physical samples
- Data sources: cruises conducted by the Integrated Ocean Drilling Program (IODP) in 2003-2013
- IODP is seen by researchers as a great example for shared data source:
  - mandatory data description and standardized metadata schemas
  - curators responsible for keeping records of all samples
  - open access to the metadata

Technical Opportunities for SaaS

- Convenience and possibly reduced costs for purchasing, installing, upgrading, and maintaining tools
- High capacity data storage & transmission
- Advanced analytic, visualization, and information management tools
- Ability to transfer data from multiple sources to facilitate analysis
- Facilitated data preparation & documentation
- Multiple user profiles with different levels of access
- Education section on policy issues surrounding data sharing
- Facilitating data licensing for enhanced data sharing

Data Management in the Long Tail: Conclusions

- Long-term access to locally kept data requires resources, staffing, expertise, investments and planning in knowledge infrastructures
- Potential for SaaS and other cloud-based computer services for specific aspects of data management and curation
- Questions of local IT support, local adaptability vs. global integration, and long-term institutional commitments to data management and curation remain to be addressed

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