# An e-Infrastructure for Language Documentation on the Web

Gary F. Simons, *SIL International*

William D. Lewis, *University of Washington*

Scott Farrar, *University of Arizona*

D. Terence Langendoen, *National Science Foundation*

# Goals

- To provide a means by which the digital products of the linguistics community's efforts to document all the world's languages will:
  - Endure far into the future;
  - Be found and used by any who have an interest in those languages;
  - Be unified in such a way that knowledge about those languages can be made readily available.

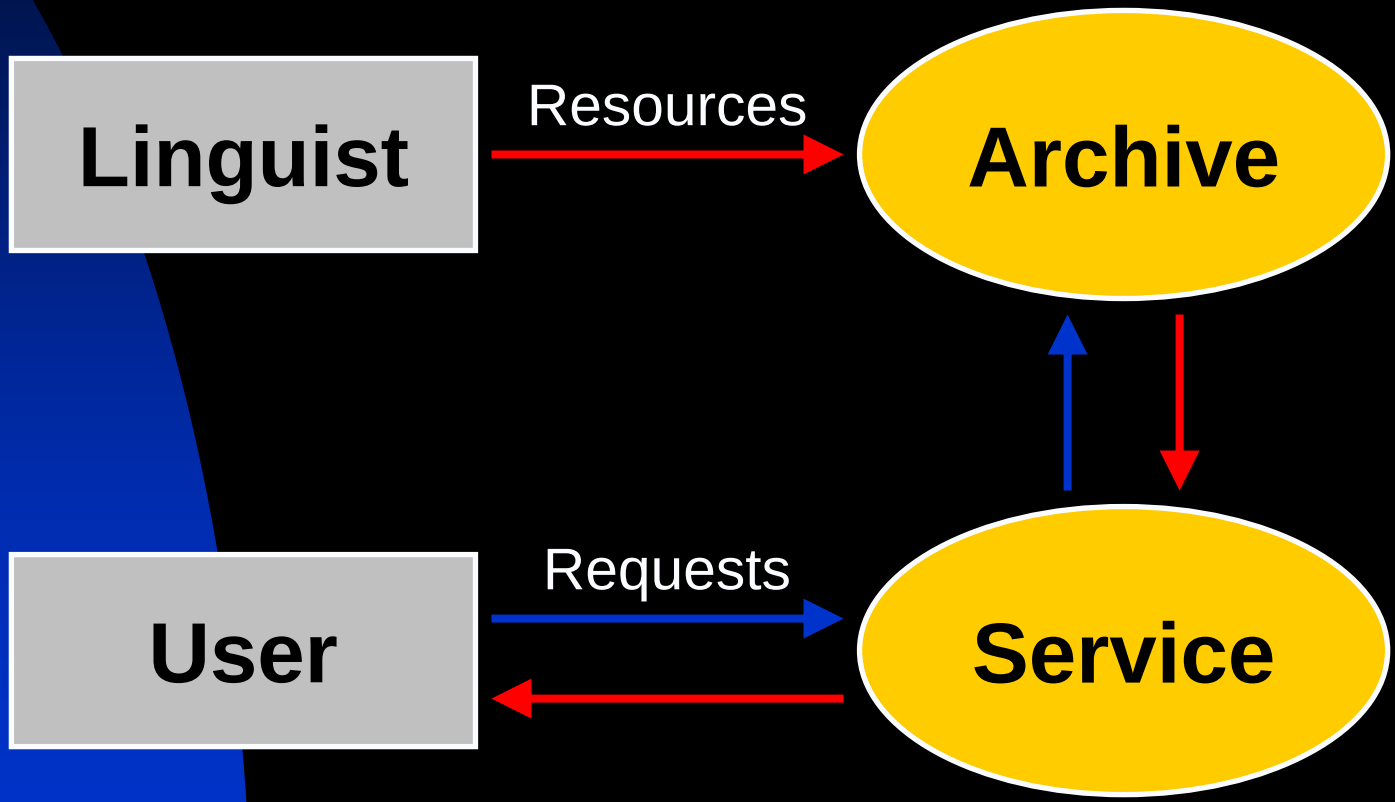
# The interoperation problem

- Once the resources that linguists create are being preserved for the future in a host of e-accessible archives:
  - How can users find the resources they are interested in?
  - How can users search the combined work of different researchers and projects, especially when they have used different markup or terminology?

# The players

| | |
|---|---|
| **User** | A person who wants to use language resources |
| **Linguist** | A person who creates language resources |
| **Archive** | An institution that curates language resources |
| **Service** | An institution that enables language resource interoperation |

# A visualization



# Shallow vs. deep interoperation

- Shallow interoperation
  - Based on the surface content of plain text
  - Generic to all problem domains
  - Based on the ubiquitous HTTP infrastructure
- Deep interoperation
  - Based on underlying concepts and structures
  - Built for a specific problem domain
  - Based on a domain-specific infrastructure (e.g. protocols, markup, controlled vocabularies)

# Supporting shallow interoperation

- Such services already exist, e.g. Google.
- If an archive exposes its catalog as web pages, it will have shallow interoperation at the level of metadata.
- If an archive provides web links to resource content, it will have shallow interoperation at the level of data content.
- Easy for the archive to do and easy for the user to use.

# Low precision and recall in shallow search

- Using Google to look for an Ega dictionary
- Ega dictionary (120,000 hits)
  - EGA is an acronym inter alia for Enhanced Graphics Adapter and Enterprise Grid Alliance.
  - Out of top 100 hits, only 2 are relevant:
    - ✓ #19: E-MELD School of Best Practice: Ega Lexicon
    - ✓ #92: Endangered Language Foundation
- Ega lexicon (24,500 hits)
  - ✓ #1: E-MELD School of Best Practice: Ega Lexicon
  - ✓ #2: Ega Web Archive (at Bielefeld)
  - Next 98 hits include 4 that refer to the language

# An example of deep search

- The Open Language Archives Community (OLAC) uses controlled vocabulary to identify:
  - Language (ISO 639-3 three-letter codes);
  - Resource type.
- Language code='ega' and Type='lexicon' (6 hits)
  - All are *relevant* items from the University of Bielefeld Language Archive.
    - Includes typescripts, recording and transcripts of word lists
    - Also includes data files in various formats, e.g. Shoebox, XML, CSV

# Supporting deep interoperation

- An archive supports deep interoperation if:
  - Its resources use XML markup so that machines may interpret their contents;
  - The XML encoding uses domain-specific controlled vocabularies;
  - It implements the protocol of a domain-specific service so that the service can access its deep resources.

# Dimensions of service

- Closed vs. Open
  - *Closed*: Only people inside the service know how to place new resources into the service.
  - *Open*: The specifications for entering the service are published and people outside the service can meet them.
- Generic vs. Specific
  - *Generic*: Supports domain-neutral shallow interoperation.
  - *Specific*: Supports domain-specific deep interoperation.
- Examples
  - Google: Open + Generic
  - Typical language typology projects: Closed + Specific

# Further open + specific dimensions of service

- Metadata vs. Content
  - *Metadata*: The service operates over metadata only.
  - *Content*: The service operates over (aspects of) full content.
- Supplied vs. Added
  - *Supplied*: The depth is encoded in the form provided by archives.
  - *Added*: The depth is mined from shallow resources.
- Examples
  1. OLAC: Metadata + Supplied
  2. Metaschema experiments: Content + Supplied
  3. ODIN: Content + Added

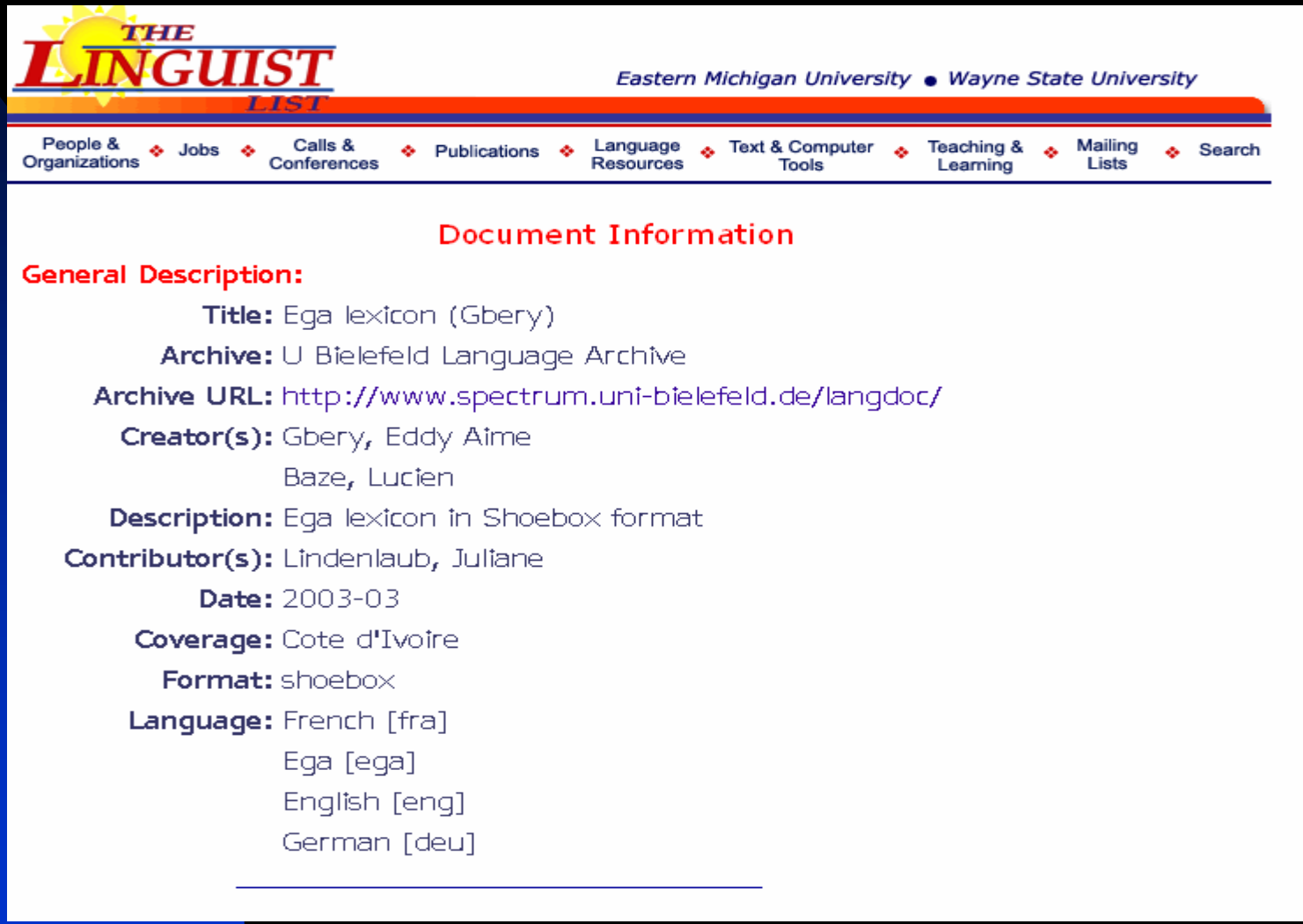
# *Example 1*. Metadata-enriched interoperation

- OLAC: Open Language Archives Community
  - An open standard for metadata and protocol for harvesting: http://www.language-archives.org
- 34 institutions now participate by contributing to a pooled catalog of language resources.
- LINGUIST List has developed a search service over that catalog:
  - http://linguistlist.org/olac/

# What the archive supplies

```
- <olac:olac xsi:schemaLocation="http://www.language-archives.org/OLAC/1.0/
  http://www.language-archives.org/OLAC/1.0/olac.xsd
  http://purl.org/dc/elements/1.1/
  http://www.language-archives.org/OLAC/1.0/dc.xsd http://purl.org/dc/terms/
  http://www.language-archives.org/OLAC/1.0/dcterms.xsd">
    <title>Ega lexicon (Gbery)</title>
    <creator>Gbery, Eddy Aime</creator>
    <creator>Baze, Lucien</creator>
    <subject xsi:type="olac:language" olac:code="ega"/>
    <description>Ega lexicon in Shoebox format</description>
    <publisher>unpublished</publisher>
    <contributor>Lindenlaub, Juliane</contributor>
    <date>2003-03</date>
    <type xsi:type="olac:linguistic-type" olac:code="lexicon"/>
    <format>shoebox</format>
    <language xsi:type="olac:language" olac:code="fra"/>
    <language xsi:type="olac:language" olac:code="ega"/>
    <language xsi:type="olac:language" olac:code="eng"/>
    <language xsi:type="olac:language" olac:code="deu"/>
    <coverage>Cote d'Ivoire</coverage>
  </olac:olac>
```

# What the service reports



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Document Information

General Description:

**Title:** Ega lexicon (Gbery)
**Archive:** U Bielefeld Language Archive
**Archive URL:** http://www.spectrum.uni-bielefeld.de/langdoc/
**Creator(s):** Gbery, Eddy Aime
Baze, Lucien
**Description:** Ega lexicon in Shoebox format
**Contributor(s):** Lindenlaub, Juliane
**Date:** 2003-03
**Coverage:** Cote d'Ivoire
**Format:** shoebox
**Language:** French [fra]
Ega [ega]
English [eng]
German [deu]

# *Example 2*. Content-supplied interoperation

- How do you interoperate across resources
  1. When those resources use different markup schemas?
  2. When linguists have used different terminologies in their analyses and descriptions?
- Both questions can be answered by providing a machine-readable semantics for XML syntax and (parts of) the content of resources.
- To this end, we're developing two resources:
  - SIL (Semantic Interpretation Language)
  - GOLD (General Ontology for Linguistic Description) http://linguistics-ontology.org/

# Converting from markup to meaning

- Markup schema
  - A formal definition (as with XML DTD or XML Schema) of the vocabulary and syntax of markup for a class of source documents.
- Semantic schema
  - A formal definition (as with RDF Schema or OWL) of the concepts in a particular domain.
- Metaschema
  - A formal definition of how the elements and attributes of a markup schema are interpreted in terms of the concepts of a semantic schema.

# A sample Hopi lexical entry

```
<Lexeme id="L28">
  <Head><Headword>
      <OrthographicForm>na('at)</OrthographicForm>
  </Headword></Head>
  <POS>
    <Feature name="cat">n</Feature>
    <Feature name="type">poss</Feature>
  </POS>
  <Sense><Gloss>
      <OrthographicForm>father. The term is applied to
        one's natural father.</OrthographicForm>
  </Gloss></Sense>
</Lexeme>
```

# A metaschema fragment

```
<interpret markup="Lexeme">
  <resource concept="gold:LinguisticSign"/>
</interpret>
<interpret markup="Head">
  <property concept="gold:form">
    <resource concept="gold:PhonologicalUnit“/>
  </property>
</interpret>
<interpret markup="OrthographicForm">
   <literal concept="gold:orthographicRepresentation"/>
</interpret>
```

# The interoperable interpretation

```
<gold:LinguisticSign rdf:about="#element(L28)">
  <gold:form>
    <gold:PhonologicalUnit>
      <gold:orthographicRepresentation>na('at)
      </gold:orthographicRepresentation>
    </gold:PhonologicalUnit>
  </gold:form>
  <gold:meaning>
    <gold:SemanticUnit>
      <gold:definition>father. The term is applied to one's natural
        father,</gold:definition>
    </gold:SemanticUnit>
  </gold:meaning>
  <gold:grammar>
    <gold:GrammaticalUnit>
      <gold:hasPartOfSpeech rdf:resource="&gold;Noun" />
      <gold:hasFeature rdf:resource="&gold;InalienablyPossessed" />
    </gold:GrammaticalUnit>
  </gold:grammar>
</gold:LinguisticSign>
```

# Results to date

- Proof of concept on a small scale using Sesame, an open-source RDF database:
  1. Lexicons from 3 languages
  2. Interlinear glossed texts from 7 languages
- See papers by Simons *et al.* at http://emeld.org

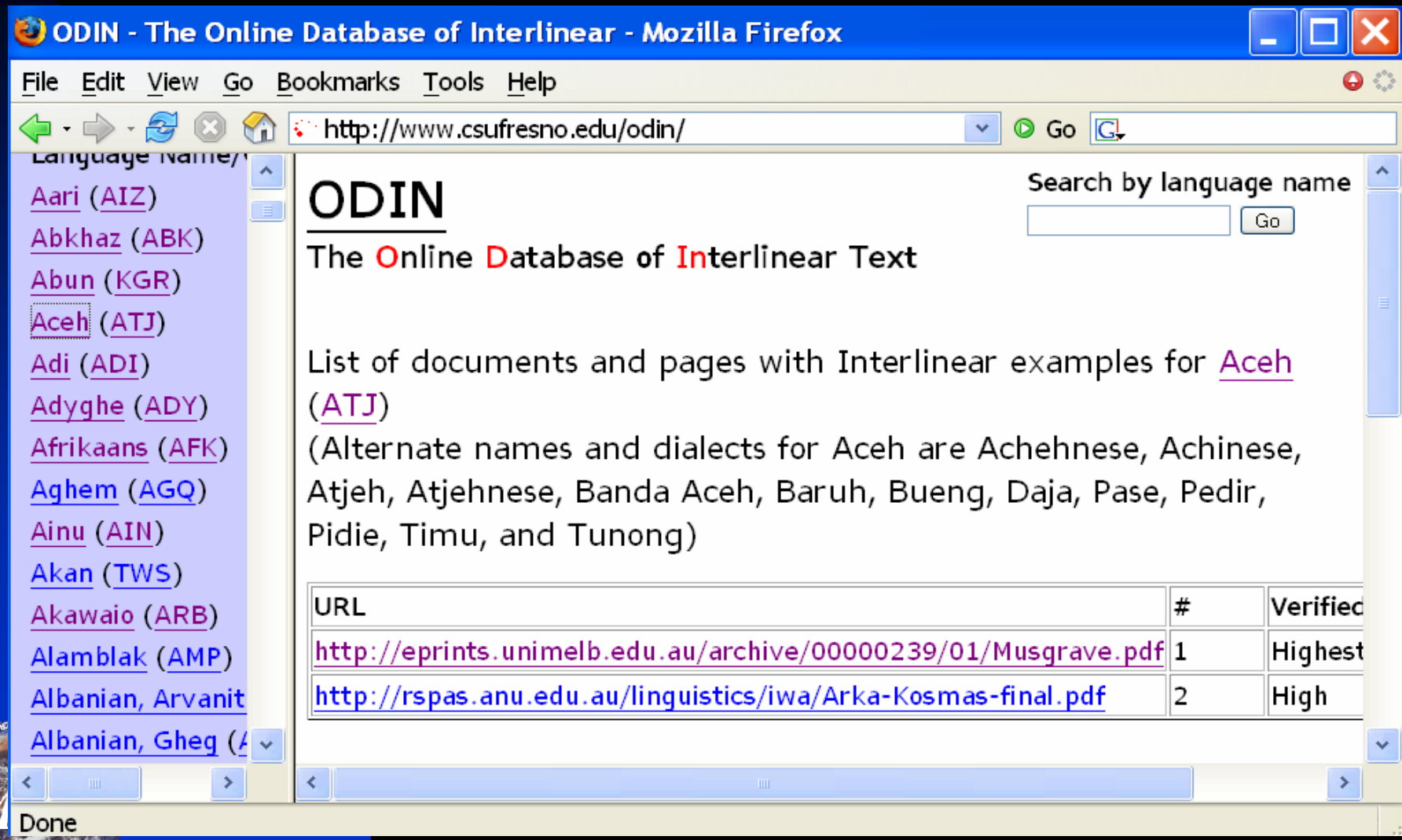
# Moving the solution out of the lab

- Analysts need to bridge the interoperation gap by creating and archiving metaschemas.
- Services can then harvest original resources + metaschemas and output interoperable resources that can be used for querying or further processing.
- Robust open RDF database technology is required.

# *Example 3*. Content-added interoperation

- ODIN: Online Database of Interlinear Text
  - http://www.csufresno.edu/odin/
- Discussed in papers by Lewis at http://emeld.org/
- Methodology
  - Seed Google search with abbreviations used in glossing.
  - Keep URL if content has instances of text-gloss-translation.
  - Use ISO 639-3 language names to propose language identify.
  - Use GOLD to interpret selected glosses, and (English) translation to identify certain grammatical construction types (can be semi-automated).
- Service recently reported:
  - 33,713 instances of Interlinear Glossed Text examples,
  - from 701 different languages, and
  - in 2,202 different linguistic documents.

# What the user sees



# What another service sees

```
- <olac:olac>
    <dc:title>Interlinear Glossed Text for Aceh</dc:title>
    <dc:creator>Lewis, William</dc:creator>
    <dc:subject xsi:type="olac:language" olac:code="x-sil-ATJ">
    Aceh</dc:subject>
  - <dc:description>
      A listing of Web resources containing Interlinear Glossed Text for
      the language Aceh: 2 document(s), 3 instance(s) of interlinear text.
    </dc:description>
    <dc:publisher>California State University, Fresno, ODIN
    project</dc:publisher>
    <dc:date>2005-02-02</dc:date>
  - <dc:identifier>
      http://www.csufresno.edu/odin/igt_urls.php?lang=ATJ
    </dc:identifier>
  </olac:olac>
```

# Empowerment through services

- **P**recision
  - Through use of domain-specific standards.
- **O**penness
  - Anyone can implement the supporting protocol.
- **W**eb harvesting
  - From resources on the Internet.
- **E**nrichment
  - Adding depth to shallow resources.
- **R**each
  - Enabling search for resources from everywhere at once.