Boundary objects as interfield phenomena: From sociological phenomena to information system artifacts

Laura Ridenour
KOrg, School of Information Studies
University of Wisconsin-Milwaukee
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Introduction

• The sociological concept known as the boundary object can be identified in multiple contexts

• Interfield theories are theories that serve to bridge two or more areas of science

Is an interfield theory itself a boundary object?
INTERDISCIPLINARIETY

SCIENCE
CAN TELL YOU
HOW TO CLONE A
TYRANNOSAURUS
REX

HUMANITIES
CAN TELL YOU
WHY THIS MIGHT
BE A BAD IDEA
Background: Context

How did I come to this?
• Worked in IT at a Fortune 500 semiconductor manufacturer
• Master’s degree in Information Science at Indiana University’s iSchool (2011-2013)
• Started my doctoral studies at the University of Wisconsin-Milwaukee’s iSchool (2013-present), part of KOrg
Context: Continued

• Noticed: People who should have been collaborating together were not, or were unaware of the others’ existence
• Realized that part of my job was to connect people to other people and systems
• Tied this into Nonaka and Bao, and Bowker and Star
Context: In-betweenness

Classification

Information needs

Information retrieval

?
Considerations (Caveats)

• Classification should reflect was is (or was)
• Science evolves, new areas of science emerge, others cease to exist
  • Classification is created based on science done in the past
• Categorization is arbitrary, and changes over time
• Boundaries in science must be established, defined, and quantified in order to meaningfully compare concepts between and across disciplinary boundaries (Szostak 2004)
Disciplines and Interdisciplinary

**Disciplines:**
- Disciplinarity implies a state of self-identity that can be either reinforced or broken down over time (Sugimoto and Weingart 2015)
- “Separatedness”

**Interdisciplinarity:**
- “The quality or fact of involving or drawing on two or more branches of knowledge” (Dictionary)
Disciplinary Constraints

- Social restriction
- Tradition
- Availability of data
- Education
The Boundary Object

- Sociological concept. Bowker and Star: something that resides between multiple social worlds.
- Star and Griesemer (2010):
  - The object (remember, to read this as a set of work arrangement that are at once material and processual) resides between social worlds (or communities of practice) where it is ill structured.
  - When necessary, the object is worked on by local groups who maintain its vaguer identity as a common object, while making it more specific, more tailored to local use within a social world, and therefore useful for work that is NOT interdisciplinary.
  - Groups that are cooperating without consensus tack back-and-forth between both forms of the object. (604-605)
Boundary Objects

• Viewed as:
  • Concrete
    • Physical objects or artefacts, codified knowledge
  • Abstract
    • Theories
  • Events
  • Tools for translation
    • Ontologies
  • Social
ABSTRACT

Boundary Concept

Pivot Point - linguistic

“Polycontextuality” - education

Structural Holes - social network analysis

Catchall Object - event

Boundary Object - “sufficiently structured”

Mediating Artefacts - CHAT

CONCRETE
Boundaries

• Boundaries MUST be defined for “boundary work” to take place (Szostak 2004)
Acts of boundary crossing in
Information

- Publication in a research area outside of one’s “home”
- Borrowing ideas (evidenced through citation outside of parent discipline)
- Bridging ideas
- Borrowing methodology
Boundary work in publications

• Borrowing theories (Hall 2003)
• Publication outside of an author’s parent discipline (Pierce 1999; Larivière, Sugimoto, and Cronin 2012)
• Co-authorship (multi-disciplinary, multi-institutional)
Interfield Theory

• An interfield theory is one that inhabits multiple disciplines, or “branches of science” and can be examined from

• They outlined the necessary conceptual, as opposed to sociological, functions of problems and facts used to gather and solve them. A theory that works to bridge scientific disciplines, or fields

• The necessary conceptual, as opposed to sociological, functions of problems and the facts gathered to solve them
Sharing of Knowledge (Dahlberg)

- Physical distance
- Culture
- Education

- Encode and share knowledge

Dahlberg (2006)
Cross-disciplinary interactions

- Cross-disciplinary
- Transdisciplinary
- Interdisciplinary
- Multidisciplinary
Interfield interactions

Five patterns of cross-disciplinary connections have been identified by Bechtel (1986, 46-47):

- Developing conceptual links between disciplines to adopt and modify perspectives from one to the other without overwhelming the adopting discipline with theoretical structures
- Recognizing a new level of organization (such as a new field or theory) in order to solve unsolved problems in existing fields
- Adoption of techniques and methods from one field to another to help build on theories in the adopting discipline
- Modifying and extending theoretical frameworks from one domain to another
- Development of new theoretical frameworks to integrate and synthesize research from separate domains
Trans-disciplinary connections

Interdisciplinarity is “linkages between specialties of diverse subject matters” (Garfield, Malin, and Small 1978 189).
Interfield Theory and Boundary Work

• “Criteria need to be able to distinguish between disciplines, subdisciplines, and supradisciplines” (Darden and Maull 1977 45).

• The structure of subspecialties and disciplines can be examined using the Science Citation Index.
Identifying Boundary Objects

Cognitive work analysis
- Identifying "pivot points" (Marchese and Smiraglia)

Natural language processing

Graph-based identification

Concept matching using concept-based thesauri
Measuring interdisciplinarity (1)

• The simplest measurement of interdisciplinarity is the number of categories cited by a work (Moed 2015)

• At any given historical period, the interdisciplinary richness of any two exemplars of knowledge, research, and education can be compared by weighing four variables: number of disciplines, the distance between them, novelty, and integration. (Nissani 1995)
Measuring interdisciplinarity (2)

• Efforts to measure interdisciplinarity include:
  • Shannon diversity index (Shannon-Wiener Index)– measures how interdisciplinary a text is based on the spread of its citations. Originally used to quantify entropy in text. (Shannon 1948).
  • Herfindhal index – statistical measure of concentration from economics (Rhoades 1993)
  • Journal Citation Reports (JCR) and Essential Science Indicators from the Web of Science (Garfield 1991; Thomson Reuters 2013)
  • Porter and Rafols measure of interdisciplinarity – integration calculation of Web of Science Subject Categories and journals cited by an article (Porter and Rafols 2009)
a priori

hybrid approaches

a posteriori

- knowledge organization
- information retrieval

- bibliometrics
- natural language processing
Classification

Information retrieval

Bibliometrics
Examining interdisciplinarity: Methods

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<tr>
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<th>a posteriori</th>
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<tr>
<td>classification</td>
<td>Bibliometric methods</td>
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<td>Network-based or graph-based approaches</td>
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<td>Domain analysis</td>
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</table>
Examining boundaries in data

- Boundaries to be artificially and strictly imposed; conversely, multiple assignment may muddle them
- Classification
  - Web of Science
    - Research areas
    - Subject categories
  - SCOPUS
    - All Science Journal Classification Codes (ASJC)
- Institutional
- Terminological
- Traditional
Examining concepts vs. classification in data

- Co-word analysis (shared language)
- Topic modeling
- Qualitative methods
Identifying Areas Boundary Objects in Information Systems

• Conceptual
  • Shared noun phrases, or n-grams in titles, abstracts, and full-text
    • Comparing frequencies of occurrence between samples
    • Overall percentages

• Software:
  • Wordstat
  • Concordancing software (antconc, others)

• Origin
  • Citation analysis
    • Sources shared by multiple domains

• Social
  • Publication habits of authors
Identifying Areas Boundary Objects in Information Systems

- Goal: Examine an in-between area
- Bibliometric query
  - Gather results from WoS
- Added ESI top-level category
- Selected two areas based on Map of Science proximity
- Examined n-grams shared by each category
- Citations by category:
  - Authors publishing in each category
  - Documents cited by each category
Identifying Shared Concepts

Phrases in Both Domains Occurring 7 or More Times

(Ridenour 2016a, Figure 2)
Compare Percentage of n-gram Overlap

Phrases: Boundary Objects in Abstracts

- Economics: 30%
- Shared: 61%
- Social Sciences: 9%

(Ridenour 2016a, Figure 5)
Results: Cited and co-cited papers

Economics and Business: 1567 unique citations

Social Sciences: 1810 unique citations

75 shared Unique citations, Cited 3579 times
Results: Authors

Economics and Business: 595 total authors

Social Sciences: 440 total authors

12 authors
## Results: Shared authors

<table>
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<tr>
<th>Author</th>
<th>Social Sciences</th>
<th>Economics</th>
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<tbody>
<tr>
<td>Cooren, F</td>
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<td>Muniz, ASG</td>
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<tr>
<td>Van Der Krogt, FJ</td>
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## Results: boundary spanning authors and expanded subject categories

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<tr>
<td>Cooren, F</td>
<td>Communication; Social Sciences Other Topics; Sociology</td>
<td>Business &amp; Economics; SS Other Topics</td>
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<td>Engineering; Business &amp; Economics; Operations Research &amp; Management Science</td>
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Why?

• Examining boundary objects in information systems can help identify areas where classification should be improved

• Consider the heterogeneity of information, and to help improve access (transmission across boundaries)

• Better improve our understanding of science
What can be done?

• When you are looking at your metrics, go deeper. Don’t be afraid to add value to your data, and examine the underlying classificatory structures, as they can illuminate previously unexplored

• Underlying structures, terminology

• Classification must adapt its focus from categorizing the psychologizing of epistemologies to the categorization of problems at and how they are addressed
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Bibliography

- http://www.lauraridenour.com/ridenourknowescapebibliography/
Questions?

- riddenour@uwm.edu