eXtensible Catalog

Software Portfolio

David Lindahl, Co-Executive Director, XCO
eXtensible Catalog (XC) is open source, user-centered, next generation software for libraries.

XC provides a *discovery interface* and a *set of tools* for libraries to manage metadata and build applications.
Software Overview

- **User Interface:**
  - Faceted, FRBRized, customizable search interface
  - Web application framework for libraries

- **Metadata Tools:**
  - Automated metadata processing: Enable libraries to aggregate metadata and run services on it

- **XC Schema**
  - New XML schema with Dublin Core terms, RDA elements and roles, MARC vocabularies, and XC elements
  - FRBR levels +: Work, Expression, Manifestation, Holdings, Item

- **Connectivity Tools:**
  - Harvest and synchronize metadata with OAI-PMH
  - Circulation and authentication with NCIP
Partners and Contributors

- University of Rochester
- The Andrew W. Mellon Foundation
- Consortium of Academic and Research Libraries in Illinois (CARLI)
- University of Notre Dame
- Rochester Institute of Technology
- Kyushu University working with NTT-Data
- University of North Carolina at Charlotte
- Serials Solutions
- OCLC
- University at Buffalo
- Cornell University
- Yale University
- Ohio State University
- Nylink
• Discovery interface and library web application platform in one
• Faceted, FRBRized search of XC Schema metadata
• Extensive, easy customization
• Established open source community
• Data-driven web applications with web forms
Harry Potter

Sort by: No sorting  Results per page: 10
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<th>Published</th>
<th>Date</th>
<th>Format</th>
<th>Abstract</th>
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TITLE: Harry Potter and the half-blood prince /
CREATORS/AUTHORS: Rowling, J. K.  (Search WorldCat Identities)
EDITION/FORMAT: Text 1st American ed.

Find a Copy
Location | Availability | Call number
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Rhees Popular Reading | Available | PZ7.R79835 Half 2005 > Map it

Details
GENRE/FORM: Juvenile fiction — Text
MATERIAL TYPE: Fiction
DOCUMENT TYPE: Text
OTHER CONTRIBUTORS: GrandPré, Mary, Ill. (contributor)
ISBN: 0439784549
NOTES: "Year 6"--Spine. — Sequel to: Harry Potter and the Order of the Phoenix.
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<td>RESPONSIBILITY:</td>
<td>by J.K. Rowling ; illustrations by Mary GrandPré.</td>
</tr>
<tr>
<td>ABSTRACT:</td>
<td>Harry Potter is beginning his sixth year at Hogwarts School of Witchcraft and Wizardry.</td>
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**Similar items**

**RELATED SUBJECTS:** Topic

- Potter, Harry (Fictitious character)-Juvenile fiction
- Hogwarts School of Witchcraft and Wizardry (Imaginary organization)-Juvenile fiction
- Wizards-Juvenile fiction
- Magic-Juvenile fiction
- Schools-Juvenile fiction
- Potter, Harry (Fictitious character)
- Hogwarts School of Witchcraft and Wizardry (Imaginary organization)
- Wizards
- Magic
- Schools

**Region**

- England-Juvenile fiction
- England

**BROWSE SIMILAR ITEMS:**

- Harry Potter and the chamber of secrets / by Rowling, J. K.
- Harry Potter and the deathly hallows / by Rowling, J. K.
- Harry Potter and the sorcerer's stone / by Rowling, J. K.
- Harry Potter and the sorcerer's stone
TITLE: Harry Potter and the half-blood prince /
CREATORS/AUTHORS: Rowling, J. K. (Search WorldCat Identities)
EDITION/FORMAT: Text 1st American ed.

Find a Copy

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<td>Magic (@type=&quot;dcterms:LCSH&quot;)</td>
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</table>
The XC Schema combines metadata fields from multiple standard schemas (RDA and DC) plus adds new XC schema elements.
<table>
<thead>
<tr>
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<th>value</th>
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</thead>
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</table>
• New XML metadata schema
  – Dublin Core terms
  – RDA - 22 elements and 11 roles designators
  – XC elements (contain MARC vocabularies, linking fields, etc)
• Subset of RDA chosen to retain the granularity in current MARC data:
  – Frequency
  – Numbering of Serials
  – Coordinates of Cartographic Content
  – Plate number (music)
• FRBR Group 1 Entities +
  – Work
  – Expression
  – Manifestation
  – Holdings
  – Item
Creating XC Schema data from MARC

- Parse MARCXML records into linked FRBR-based records
- MARC Holdings records produce XC Holdings records (to preserve MARC granularity)
- All XC records have globally unique identifiers, and a permanent host repository
- Uplinks created
Metadata

Metadata Issues and XC Metadata Management Tools
• Users have many starting points for search because all the data is not available in a single system:
  – Integrated Library Systems
  – Institutional Repositories
  – Webpages
  – Subscription Databases

• Libraries don’t have good options for searching across all of these sources
ILS MARC export issues
Cataloging errors and variant practices
End-user generated metadata
Lack of authority control
Libraries don’t have good options for making use of data at a range of quality levels
• MARC format is everywhere but does not support current metadata needs
• Multiple formats are useful to describe a range of resources, but difficult to search across consistently
• Libraries don’t have good options to try out new standards like RDA
• ILS OPAC interfaces are deficient in:
  – Ease of learning / ease of use
  – Precision and recall
  – Finding similar and related resources
Steps:
1. Convert from raw MARC to MARCXML (minor cleanup)
2. Normalize MARCXML (major cleanup)
3. Transform from MARCXML to XC (FRBRize)
4. Aggregate at each FRBR level (match and merge)
5. Index records / create WEMs (one for each unique Manifestation)
Following one MARC record through XC

1. Convert from raw MARC to MARCXML (minor cleanup)
2. Normalize MARCXML (major cleanup)
3. Transform from MARCXML to XC (FRBRize)
4. Aggregate at each FRBR level (match and merge)
5. Index records / create WEMs (one for each unique Manifestation)

Data is ready for search and faceted browse.
XC Software Components

1. Convert
2. Normalize
3. Transform
4. Aggregate
5. Index

ILS

XC OAI Toolkit

XC Metadata Services Toolkit

XC Drupal Toolkit

DRupal CMS

Metadata Issue Handling

1. Convert
2. Normalize
3. Transform
4. Aggregate
5. Index

Metadata Issue Handling
XC OAI Toolkit

Exposé ILS metadata to XC’s next generation catalog interface and metadata tools

Synchronize ongoing changes in ILS records with XC software automatically

Convert raw MARC into MARCXML

Address data and identifier issues

Compatible with most ILSs
New type of staff client for processing large batches of metadata through an orchestrated set of services.

Harvest from multiple sources (silos) to address format and quality issues.

Aggregate and de-dupe metadata.

Automatic synchronization propagates changes in source metadata through services and on to discovery interface.
XC Metadata Services Toolkit

**MARCCXML Normalization Service**

- Transform language codes to spelled-out languages: e.g. fre becomes French
- Normalize forms of OCLC numbers so that they are all the same
- Substitute vocabulary terms for format/type of material codes in the MARC record (Leader, 006, 007, 008) to enable building facet values
- Substitute codes for audience level (juvenile, etc.) and type of material (fiction, non-fiction; identifies dissertation/thesis)
- “Deconstructs” LC Subject headings so we can map parts of them to different facets: geographic, genre, topic, etc.
**XC Metadata Services Toolkit**

- **MARCXML to XC Transformation Service**
  - Parse flat MARC records to create linked FRBR-based records (work, expression, etc.) in XC Schema
  - One input record results in several output records
  - Manage relationships between records, including one to many relationships
  - Creates multiple work and expression records for analytics
  - Handles “bound-withs” (e.g. two books bound together)

XC Metadata Services Toolkit

XC Aggregation Service

- Aggregate records that represent the same resource at:
  - Manifestation-level
  - Work-level (depends on Authority service)
- Manage relationships between records (FRBR entities, etc.)
- Enable automated synchronization of updates for records at each FRBR level
- Sets stage for future “non-MARC” RDA implementation
eXtensible Metadata Services

1. Convert
2. Normalize
3. Transform
4. Aggregate
5. Index

 XC Metadata Services Toolkit

- MARCXML Normalization
- MARCXML to XC Transformation
- XC Aggregation

- DC / Qualified DC Normalization
- DC to XC Transformation

- <other schema> Normalization
- <other> to <other> Transformation
- MARCXML / XC Authority

- XC to RDF
  (Linked data out)

- Drupal CMS

- XC OAI Toolkit
- XC Drupal Toolkit

- DSpace
- ILS
XC Drupal Toolkit

- Adds support for library metadata into Drupal (DC and XC schemas)
- Apache SOLR index of WEMs to enable faceted, FRBRized results navigation
- Single search interface across:
  - Library catalog
  - Digital repository
  - Website resources
- Extensive customization
- Integration with ILS circulation system (via XC NCIP Toolkit)
Metadata Services Toolkit (MST) Tasks

• Get metadata into the MST
  – Add Repositories
  – Schedule Harvests
• Tell MST what to do with metadata
  – Install metadata services
  – Add processing rules
• Verify results / troubleshoot processing
  – Browse records
  – View error logs

Metadata Tools
Telling the MST about a repository is easy. Assign a name of your choice and enter the URL.

After adding a repository, the MST will automatically do a “handshake” with it and provide “Success” or “Error” messages for each step in the handshake.

When successful, the MST reports on what formats and sets are available in the remote database.

The MST supports all XML schemas, but individual services are schema-specific.
The next step is to schedule the harvesting of metadata from the remote repository.

Options
- Set the schedule
- Choose start and end dates
- Select sets and formats
The next step is to install a metadata service.

A service is a separate program, written in Java, that is managed by the MST.

Services can be downloaded from the XC website or you can write your own by following the developer’s manual.

In order to use a service, you place the downloaded file in a directory by following the MST manual.

This screen can then be used to install the service in the MST.
This example shows two services already installed in this Metadata Services Toolkit (MST): MARC Normalization and MARC-to-XC-Transformation.

Now we need to tell the MST which metadata records we want processed through which services, and in what order. This is called service orchestration.

We will now add a “Processing Rule”
“Browse Records” is a feature of the MST that includes faceted browse and full-text search.

The MST has a local copy of all harvested metadata and all metadata produced by each installed service.
Library staff use “Browse Records” to verify that services are functioning properly and to debug any issues.
Whenever a record is processed by a service, the original record is preserved and one or more new records may be produced. These records are called successors.

Navigation links take you to predecessor and successor records. In this case, links connect MARC records to their normalized successor. In another case, links connect a normalized MARC record to its successor Work, Expression and Manifestation records.
Each service can register error messages with the MST upon installation. In this example the MARC Normalization service has attached errors to specific records.

Errors are facets in the MST.

The “i” icon links to a customizable webpage with instructions for staff to address the error.
Full Record Display: MARC Holdings Record

Administrative metadata managed by the MST

Predecessor and successor links

XML viewer (supports any XML schema)
Log file management system with navigation.

This page shows MST system log files. Each installed service as well as harvest-in and harvest-out logs are available.

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<tr>
<th>Log Type</th>
<th>Warnings</th>
<th>Errors</th>
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</table>

* Reset all will reset the statistic to 0 and move the log file to the archives directory
eXtensible Catalog

Take Control.
eXtensible Catalog

What’s Next
Vision for Linked Data
• The **Semantic Web** refers to a set of technologies that allow computers to understand the meaning of information on the web

• **Linked data** is a mechanism for exposing, sharing and connecting data on the web
• If *everything* has a unique identifier, then information from one website can be related to information from another via a computer program

• *Everything* includes people, places, things, vocabularies, metadata elements, web documents, ...
• A Uniform Resource Identifier (URI) is a string of characters used to identify a name (URN) or an resource on the internet (URL).

• Two kinds of resources
  – information resources – traditional web things like documents, images, etc.
  – non-information resources – these are real world objects like people, physical products, places, concepts, proteins, etc
Turning information into Linked Data

RDF Triple defined:

Subject (URI)  \(\rightarrow\)  Predicate (URI from a defined vocabulary)  \(\rightarrow\)  Object (URI or literal)

Example #1: Describe something...

Information that might be on a webpage, but cannot be readily understood by a computer: “David Lindahl is 40 years old.”

Step 1: Parse it into a Subject, Predicate, and Object:

David Lindahl  \(\rightarrow\)  foaf:age  \(\rightarrow\)  40

Step 2: Convert to URI’s:

http://xc.org/resource/dlindahl  \(\rightarrow\)  http://xmlns.com/foaf/spec/#term_age  \(\rightarrow\)  40
Turning information into Linked Data

RDF Triple defined:

Subject (URI)  Predicate (URI from a defined vocabulary)  Object (URI or literal)

Example #2: Define a relationship...

Information that might be on a webpage, but cannot be readily understood by a computer: “David Lindahl knows Jennifer Bowen.”

Step 1: Parse it into a Subject, Predicate, and Object:

David Lindahl  foaf:knows  Jennifer Bowen

Step 2: Convert to URI’s:

• XC Metadata Services Toolkit (MST):
  – Converts multiple formats into XC Schema
    • XC Schema is linked data ready
    • XC Schema uses defined vocabularies (rda, dcterms, xc)
  – Persistent OAI-PMH (web services) data repository
  – Plug-in service architecture can be extended support RDF technologies
Download XC software at eXtensibleCatalog.org
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<thead>
<tr>
<th>Format</th>
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<th>Description</th>
<th>Operations</th>
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|                   | http://dublincore.org/schemas/xmls/qdc/2008/02/11/dc.xsd |
|                   | http://purl.org/dc/terms/  
|                   | http://dublincore.org/schemas/xmls/qdc/2008/02/11/dcterm.xsd  
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|         | dcterms:coverage (attributes: xsi:type)  
|         | dcterms:creator  
|         | dcterms:isReplacedBy (attributes: dcterms:ISSN)  
|         | dcterms:relation  
|         | dcterms:replaces (attributes: dcterms:ISSN)  
|         | dcterms:spatial (attributes: xsi:type)  
|         | dcterms:subject (attributes: xsi:type ['DDC', 'LCC', 'NLM', 'aat'])  
|         | dcterms:temporal |
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- dcterms:type (attributes: xsi:type ['DCMItype'])
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- rdrole:compiler (attributes: agentID)
- rdrole:composer (attributes: agentID)
- rdrole:speaker (attributes: agentID)
- rdvoc:coordinatesOfCartographicContent
- rdvoc:dissertationOrThesesInformation
- rdvoc:identifierForTheWork (attributes: xsi:type)
- rdvoc:natureOfTheContent
- rdvoc:workTitle
- xc:coverage (attributes: xsi:type)
- xc:creator (attributes: agentID)
- xc:expressionOfWork (attributes: type)
- xc:relation (attributes: workID)
- xc:spatial (attributes: xsi:type ['$2', 'LCSH', 'MESH', 'bidex', 'gtt', 'lcac', 'nasat', 'ram', 'rasuqam', 'rvm', 'sears', 'swd'])
- xc:temporal (attributes: type ['LCSH', 'aat', 'bidex', 'cash', 'gmepc', 'jhpk', 'lcac', 'ram', 'rbgenr', 'rvm', 'sears', 'swd'])
- xc:thesisAdvisor

XC Expression
- dcterms:available
- dcterms:bibliographicCitation
- dcterms:conformsTo
- dcterms:contributor
- dcterms:dateAccepted
- dcterms:dateCopyrighted
- dcterms:description
- dcterms:educationLevel
- dcterms:hasFormat
- dcterms:hasVersion
- dcterms:instructionMethod
- dcterms:isFormatOf
- dcterms:isReferencedBy
- dcterms:isRequiredBy
- dcterms:isVersionOf
- dcterms:language (attributes: xsi:type)
Entity
- dcterms:creator
- dcterms:references
- dcterms:requires
- dcterms:source
- dcterms:version
- rdarole:director (attributes: agentID)
- rdarole:editor (attributes: agentID)
- rdarole:illustrator (attributes: agentID)
- rdarole:performer (attributes: agentID)
- rdarole:producer (attributes: agentID)
- rdarole:translator (attributes: agentID)
- rdvocab:artisticAndOrTechnicalCredits
- rdvocab:awards
- rdvocab:identifierForTheExpression (attributes: type)
- rdvocab:illustration
- rdvocab:performerNarratorAndOrPresenter
- rdvocab:placeAndDateOfCapture
- rdvocab:scale
- xc:contributor (attributes: agentID)
- xc:expressionTitle
- xc:ISO639-3LanguageName
- xc:manifestationOfExpression (attributes: type)
- xc:workExpressed (attributes: type)

XC
Manifestation
- dcterms:accessRights
- dcterms:accrualMethod
- dcterms:accrualPeriodicity
- dcterms:accrualPolicy
- dcterms:alternative
- dcterms:created
- dcterms:date
- dcterms:dateSubmitted
- dcterms:extent
- dcterms:format
- dcterms:hasPart
- dcterms:identifier (attributes: type ['ISBN'])
- dcterms:isPartOf
- dcterms:issued
- dcterms:license
- dcterms:medium
<table>
<thead>
<tr>
<th>Entity</th>
<th>Fields</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>rdvocab:soundCharacteristics</td>
</tr>
<tr>
<td></td>
<td>rdvocab:statementOfResponsibilityRelatingToTitle</td>
</tr>
<tr>
<td></td>
<td>xc:expressionManifested (attributes: type)</td>
</tr>
<tr>
<td></td>
<td>xc:holdingsOfManifestation (attributes: type)</td>
</tr>
<tr>
<td></td>
<td>xc:identifier (attributes: xsi:type ['CODEN', 'DNLM', 'GPOItem', 'GPO', 'GyFmDB', 'IAN', 'ISMN', 'ISRC', 'ISSN', 'JTNDL', 'LAC', 'SICI', 'SoundNr', 'SuDoc', 'UPC', 'UK', 'VideoNr', 'YBP', 'bbc', 'bnc', 'dnb', 'gtin-14', 'gtin'])</td>
</tr>
<tr>
<td></td>
<td>xc:isPartOf (attributes: workID)</td>
</tr>
<tr>
<td></td>
<td>xc:otherPhysicalDetails</td>
</tr>
<tr>
<td></td>
<td>xc:recordID (attributes: type ['CSTRLIN', 'DLC', 'GPO', 'HOL', 'IBatF', 'III', 'LCCN', 'MWT', 'NOTISUF', 'NOTIS', 'NRU', 'OCLC', 'OCoLC', 'OCoLC', 'PWmBR0', 'UnM', 'hol', 'CaPaEBR', 'WaSeSS'])</td>
</tr>
<tr>
<td></td>
<td>xc:type007</td>
</tr>
<tr>
<td></td>
<td>xc:typeLeader06</td>
</tr>
<tr>
<td></td>
<td>xc:typeSMD</td>
</tr>
</tbody>
</table>

**XC Holdings**

- xc:callNumber
- xc:itemOfHoldings (attributes: type)
- xc:location
- xc:manifestationHeld (attributes: type)
- xc:RestrictionsOnUse
- xc:tempLocation

**XC Item**

- xc:chronology
- xc:copyNumber
- xc:enumeration
- xc:holdingsExemplified (attributes: type)
- xc:marksInscriptions
- xc:pieceDesignation
- xc:serviceProvider (attributes: type)
- xc:status
- xc:tempLocation
Search Records
Query, facet, and view metadata records

Browse Records
Navigate through categories of metadata

My Account
Manage account and view loaned, requested, and saved items

Logout
Exit account

Sort by: No sorting
Results per page: 10

Language
- English (123813)
- French (8401)
- German (6205)
- Italian (3355)
- Spanish (1822)

More

Type of content
- Non-Fiction (125304)
- Fiction (5035)
- Juvenile (2795)

More
Alert! Advanced settings! Modify these settings very carefully, and only after you have read the manual!

The list of predefined facets. These facets should be defined before indexing. Each facet contain the content of one or more fields. We call the facet-field pairs to mapping. You can see the mappings grouped by facets or grouped by fields. You can restore default values comes with the module with click on restore defaults.

<table>
<thead>
<tr>
<th>Display name</th>
<th>Machine name</th>
<th>Solr type</th>
<th>Conditional facet?</th>
<th>view</th>
<th>edit</th>
<th>delete</th>
<th>enable</th>
</tr>
</thead>
<tbody>
<tr>
<td>Authors/Contributors</td>
<td>authors_contributors</td>
<td>string facet</td>
<td>False</td>
<td>view</td>
<td>edit</td>
<td>delete</td>
<td>disable</td>
</tr>
<tr>
<td>Classification</td>
<td>classification</td>
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<td>False</td>
<td>view</td>
<td>edit</td>
<td>delete</td>
<td>disable</td>
</tr>
<tr>
<td>Authors/Creators</td>
<td>creator_author</td>
<td>string facet</td>
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<td>delete</td>
<td>disable</td>
</tr>
<tr>
<td>Date</td>
<td>date</td>
<td>date facet</td>
<td>False</td>
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<td>disable</td>
</tr>
<tr>
<td>Format</td>
<td>format</td>
<td>string facet</td>
<td>False</td>
<td>view</td>
<td>edit</td>
<td>delete</td>
<td>disable</td>
</tr>
<tr>
<td>Genre</td>
<td>genre</td>
<td>string facet</td>
<td>False</td>
<td>view</td>
<td>edit</td>
<td>delete</td>
<td>disable</td>
</tr>
<tr>
<td>Language</td>
<td>language</td>
<td>string facet</td>
<td>False</td>
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</tr>
<tr>
<td>Other contributors</td>
<td>other_contributors</td>
<td>string facet</td>
<td>False</td>
<td>view</td>
<td>edit</td>
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</tr>
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<td>region</td>
<td>string facet</td>
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<td>delete</td>
<td>disable</td>
</tr>
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<td>Subject</td>
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<td>string facet</td>
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<td>view</td>
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</tr>
<tr>
<td>Region</td>
<td>subject.spatial</td>
<td>string facet</td>
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<td>delete</td>
<td>disable</td>
</tr>
<tr>
<td>Time period</td>
<td>subject.temporal</td>
<td>string facet</td>
<td>False</td>
<td>view</td>
<td>edit</td>
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<tr>
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<td>disable</td>
</tr>
</tbody>
</table>
**Machine name:**

authors_contributors

The machine name of facet.

**Display name:**

Authors/Contributors

The human readable name of facet.

**Solr type:**

string facet

A Solr dynamic type of facet.

**Conditional facet?:**

- **true**
- **false**

Is the facet based on conditions?

**Fields:**

- dcterms:accrualPolicy
- dcterms:alternative
- dcterms:audience
- dcterms:available
- dcterms:bibliographicCitation
- dcterms:conformsTo
- dcterms:creator
- dcterms:coverage
- dcterms:created
- dcterms:date
- dcterms:dateAccepted
- dcterms:dateCopyrighted
- dcterms:dateSubmitted
- dcterms:description
- dcterms:educationLevel
- dcterms:extent
- dcterms:format
- dcterms:hasFormat
- dcterms:hasPart

**Enabled?:**

- **true**

Is the facet enabled?
Alert! Advanced settings! Modify these settings very carefully, and only after you have read the manual!  

The list of predefined facets. These facets should be defined before indexing. Each facet contain the content of one or more fields. We call the facet-field pairs to mapping. You can see the mappings grouped by facets or grouped by fields. You can restore default values comes with the module with click on restore defaults.

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<?php
static $all_fields;
if(!isset($all_fields)) {
    $all_fields = array('xc:type007', 'dcterms:type', 'xc:typeLeader06', 'rdvocab:modeOfIssuance', 'rdvocab:dimensions', 'xc:typeSMD', 'dcterms:identifier');
}
$xc_record = _xc_sorl_to_array($doc, $all_fields, FALSE);
$fields = array('xc:type007', 'dcterms:type', 'xc:typeLeader06');
foreach ($fields as $field) {
    if(is_array($xc_record[$field])) {
    
```
The human readable name of facet.

**SOLR type:**

string facet

A SOLR dynamic type of facet.

**Conditional facet?**:

- true
- false

Is the facet based on conditions?

**Conditions:**

```php
<?php
static $all_fields;
if(!isset($all_fields)) {
    $all_fields = array('xc:type007', 'dcterms:type', 'xc:typeLeader06', 'rdvocab:modeOfIssuance', 'rdvocab:dimensions', 'xc:typeSMD', 'dcterms:identifier');
}
$xc_record = _xc_solr_to_array($doc, $all_fields, FALSE);
$fields = array('xc:type007', 'dcterms:type', 'xc:typeLeader06');
foreach ($fields as $field) {
    if(!is_array($xc_record[$field])) {
```

**Enabled?**

- true

Is the facet enabled?