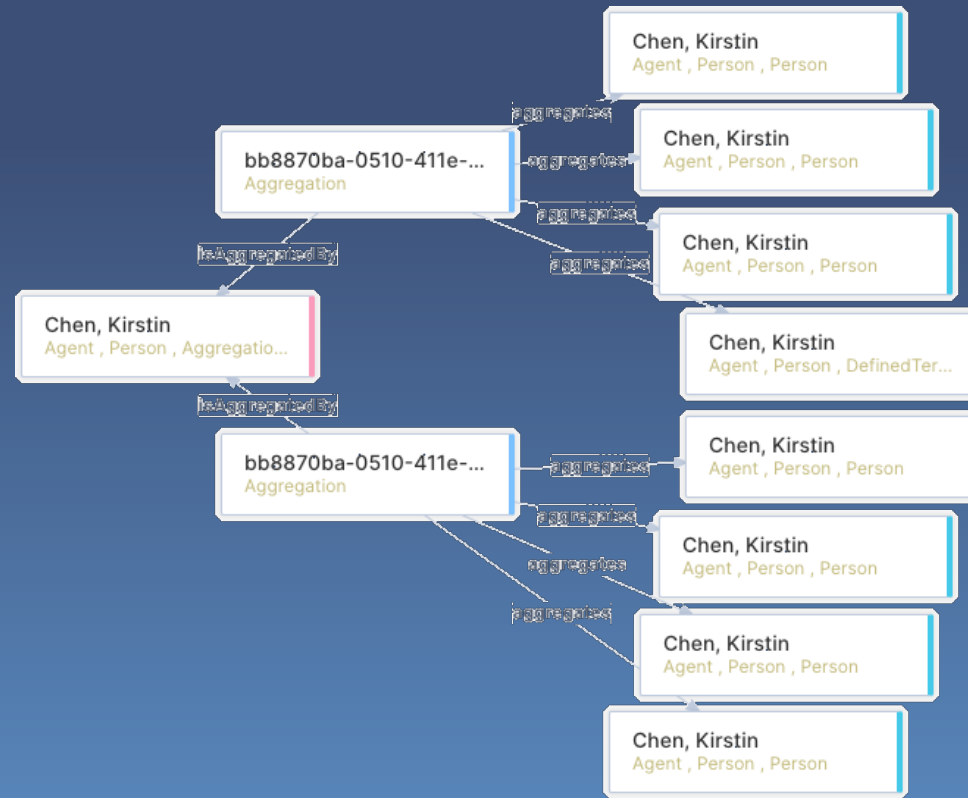
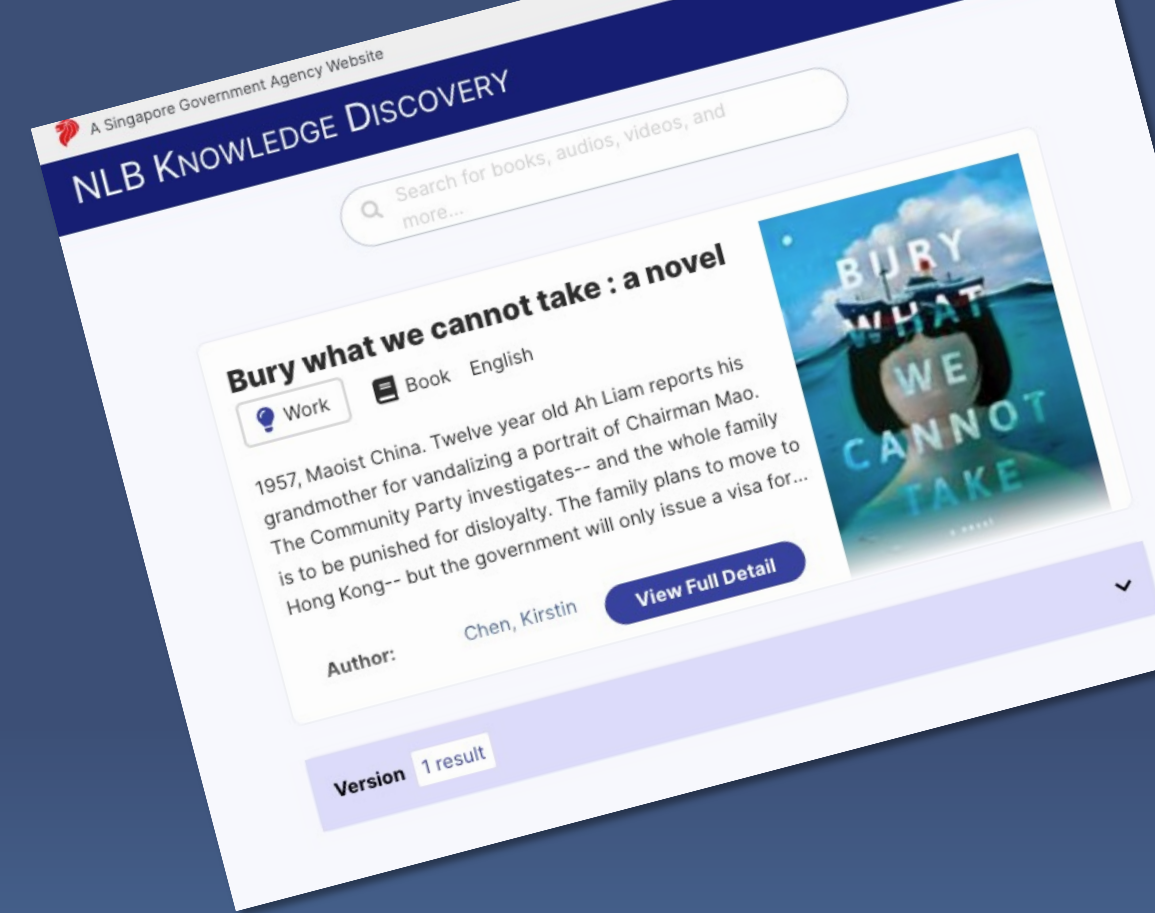


From Ambition to Go Live

The National Library Board of Singapore's Journey to an operational Linked Data Management and Discovery System



Richard Wallis
Evangelist and Founder
Data Liberate
richard.wallis@dataliberate.com
@dataliberate



BIBFRAME Workshop in Europe 2023
19th September 2023 - Brussels



Data Liberate

Independent Consultant, Evangelist & Founder

40+ Years – Computing

30+ Years – Cultural Heritage technology

20+ Years – Semantic Web & Linked Data

W3C Community Groups:

- Bibframe2Schema (Chair) – Standardised conversion path(s)
- Schema Bib Extend (Chair) - Bibliographic data
- Schema Architypes (Chair) - Archives
- Financial Industry Business Ontology – Financial schema.org
- Tourism Structured Web Data (Co-Chair)
- Schema Course Extension
- Schema IoT Community
- Educational & Occupational Credentials in Schema.org

Worked With:

- **Google** – Schema.org vocabulary, site, extensions. documentation and community
- **OCLC** – Global library cooperative
- **FIBO** – Financial Industry Business Ontology Group
- Various Clients – Implementing/understanding Linked Data, Schema.org:
 - National Library Board Singapore
 - British Library – Stanford University – Europeana



National Library Board Singapore



Public Libraries

Network of 28 Public Libraries, including 2 partner libraries*

Reading Programmes and Initiatives
Programmes and Exhibitions targeted at Singapore communities

*Partner libraries are libraries which are partner owned and funded but managed by NLB/NLB's subsidiary Libraries and Archives Solutions Pte Ltd. Library@Chinatown and the Lifelong Learning Institute Library are Partner libraries.



National Library

Preserving Singapore's Print and Literary Heritage, and Intellectual memory
Reference Collections
Legal Deposit (including electronic)



National Archives

Transferred from NHB to NLB in Nov 2012

Custodian of Singapore's Collective Memory: Responsible for Collection, Preservation and Management of Singapore's Public and Private Archival Records

Promotes Public Interest in our Nation's History and Heritage

National Library Board Singapore

Lending Collection

Over 5m
print collection

Over 1.7m
e-books and
audio books

Search a
78
databases
via the
Singapore
National
(NLB)
website

Over 2.4m
music tracks

Over 7,400
e-newspapers and
e-magazines titles

Keen to pick up a
new skill in
design, business
or more?
Over 8,000
e-learning
courses
e-learn on the go with the
NLB Mobile app!

Reference Collection

Over 560,000
Singapore &
SEA items

Over 147,000
Chinese, Malay &
Tamil Languages
items

Over 53,000
Arts items

Over 62,000
Social Sciences
& Humanities
items

Over 39,000
Science &
Technology
items

Over 19,000
Rare Materials
items

Archival Materials

Over 1.14m
Photographs

Over 290,000
Government files &
Parliament papers

Over 190,000
Audiovisual & sound
recordings

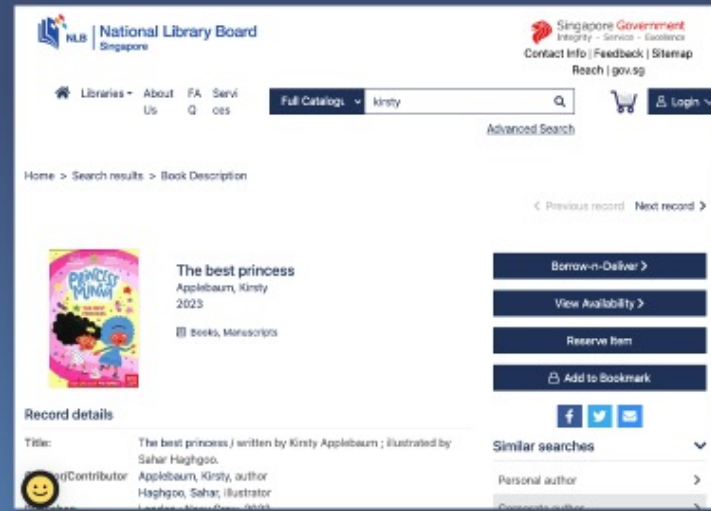
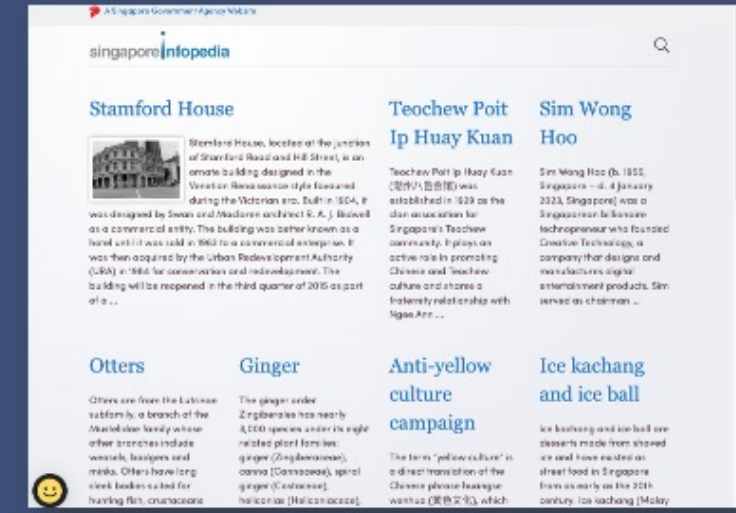
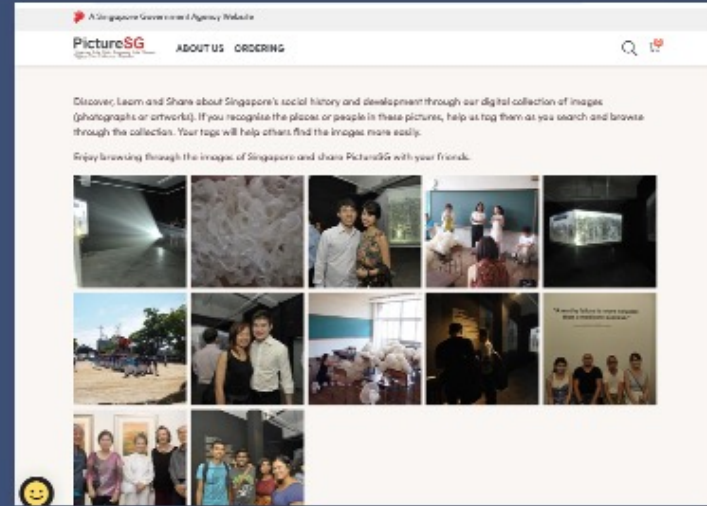
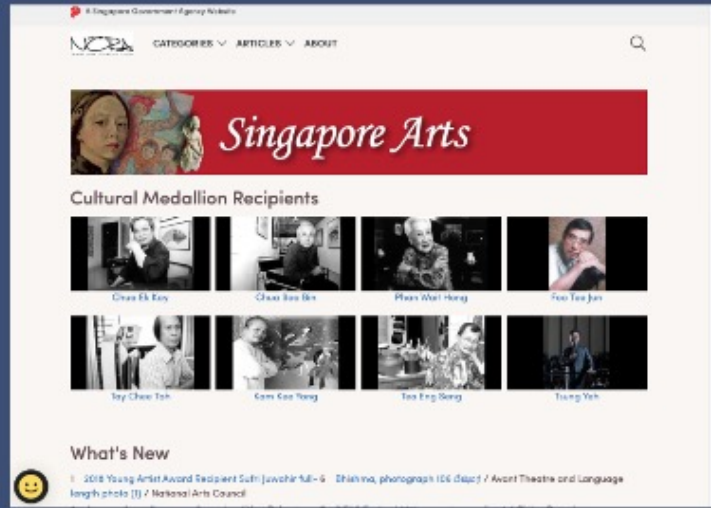
Over 70,000
Maps & building
plans

Over 55,000
Speeches & press
releases

Over 35,000
Oral history
interviews

Over 7,000
Posters

National Library Board Online Services



The Ambition

- To enable the discovery & display of entitles from different sources in a combined interface



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- To bring together resources physical and digital



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- To bring together resources physical and digital
- To bring together diverse systems across the National Library, National Archives, and Public Libraries in a Linked Data Environment



The Ambition

- To enable the discovery & display of entitles from different sources in a combined interface
- To bring together resources physical and digital
- To bring together diverse systems across the National Library, National Archives, and Public Libraries in a Linked Data Environment
- To provide a staff interface to view and manage all entities, their descriptions and relationships



The Journey Starts (March 2021)

A Linked Data Management System (LDMS)

SECTION C - REQUIREMENT SPECIFICATIONS
INVITATION TO TENDER: FOR LINKED DATA
MANAGEMENT SYSTEM AND DISCOVERY INTERFACE,
FOR NATIONAL LIBRARY BOARD, SINGAPORE

The Journey Starts (March 2021)

A Linked Data Management System (LDMS)

- Cloud-based System

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- Management Interface

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- Source data curated at source
 - ILS, Authorities, CMS, NAS

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- Public Interface – Google friendly
 - Schema.org
 - URL = URI + content negotiation (LOD)

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 - Schema.org
 - URL = URI + content negotiation (LOD)
- Shared standards
 - Bibframe, Schema.org

SECTION C - REQUIREMENT SPECIFICATIONS
INVITATION TO TENDER: FOR LINKED DATA
MANAGEMENT SYSTEM AND DISCOVERY INTERFACE,
FOR NATIONAL LIBRARY BOARD, SINGAPORE

Contract Awarded



metaphactory platform
Low-code knowledge graph platform
Semantic knowledge modeling
Semantic search & discovery



AWS Partner
Public sector partner
Singapore based



Linked Data, Structured data, Semantic Web, bibliographic meta data, Schema.org and management systems consultant

Initial Challenges

- Data – lots of it!
 - Record-based formats: MARC-XML, DC-XML, CSV



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- Entity-based search & discovery



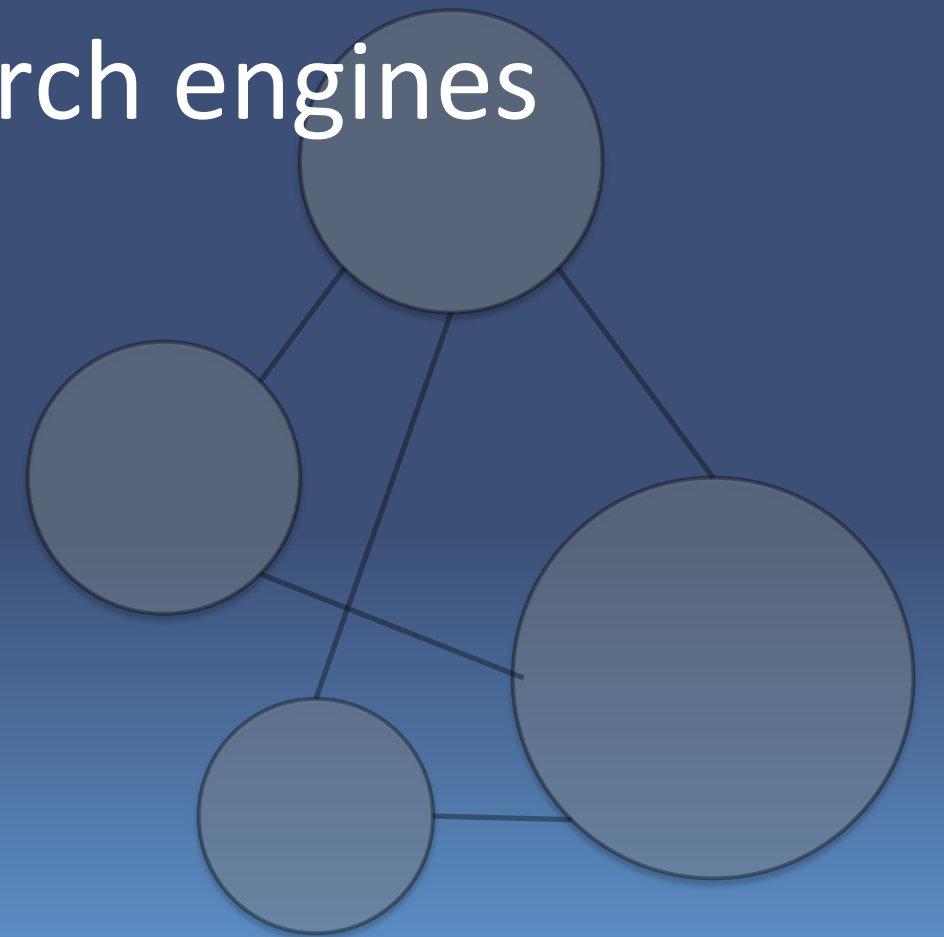
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- Regular updates – daily, weekly, monthly
- Automatic ingestion
- Not the single source of truth
- Manual update capability
- Entity-based search & discovery
- Web friendly – Schema.org output



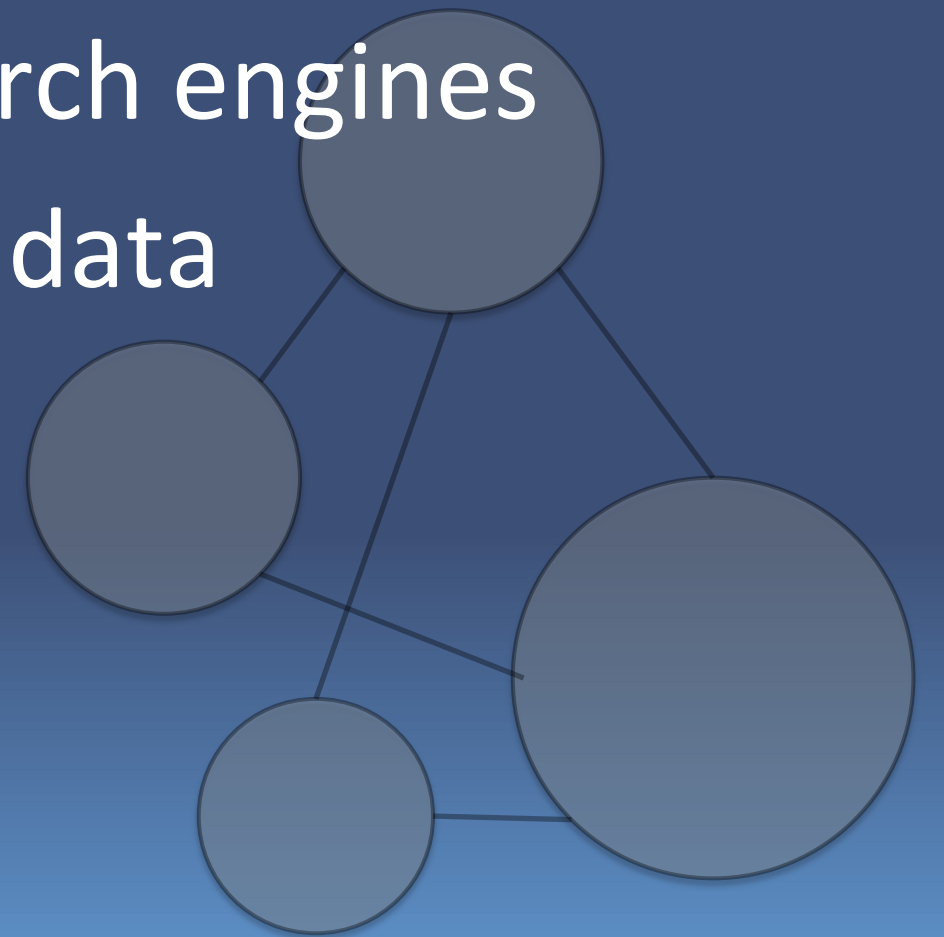
Basic Data Model

- Linked Data
 - BIBFRAME to capture detail of bibliographic records
 - Schema.org to deliver structured data for search engines



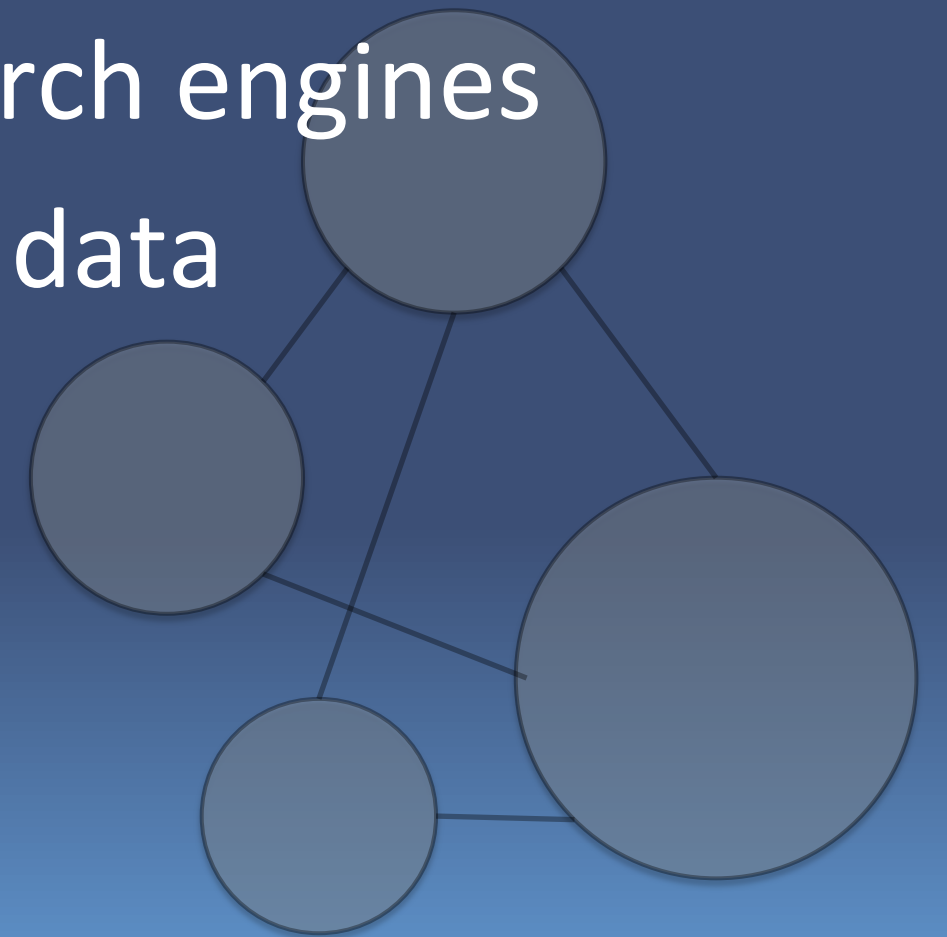
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 - Schema.org representation of CMS, NAS, TTE data



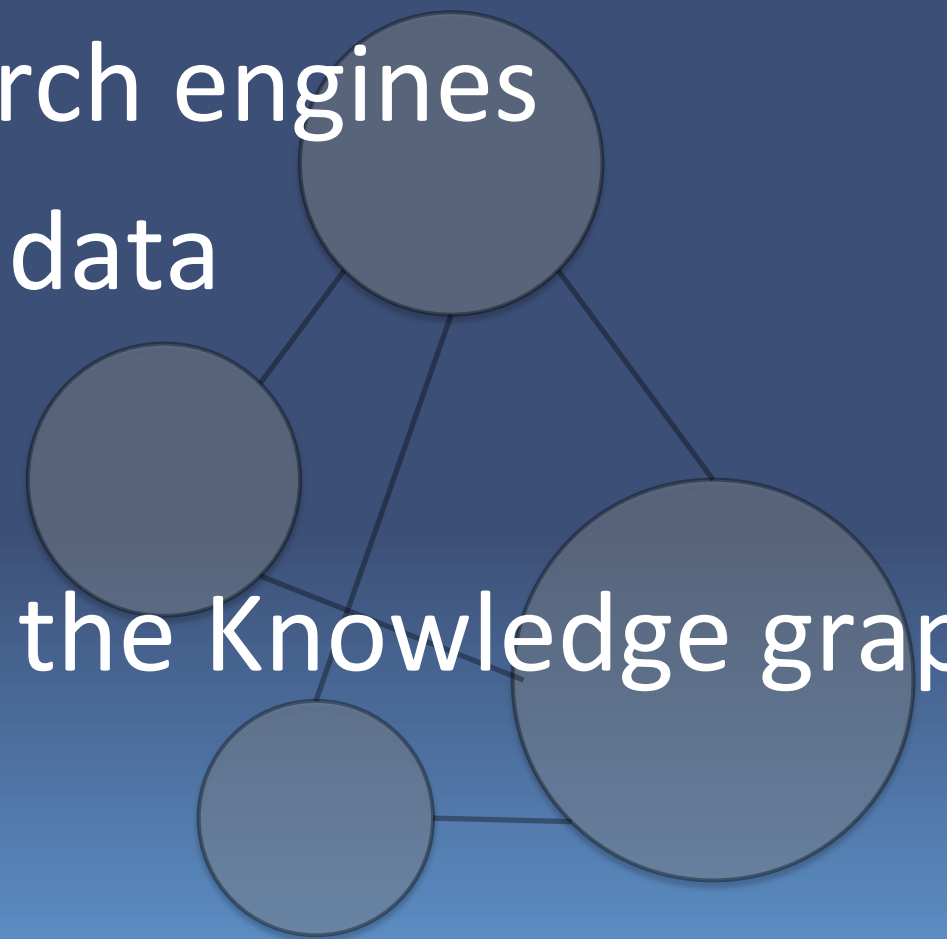
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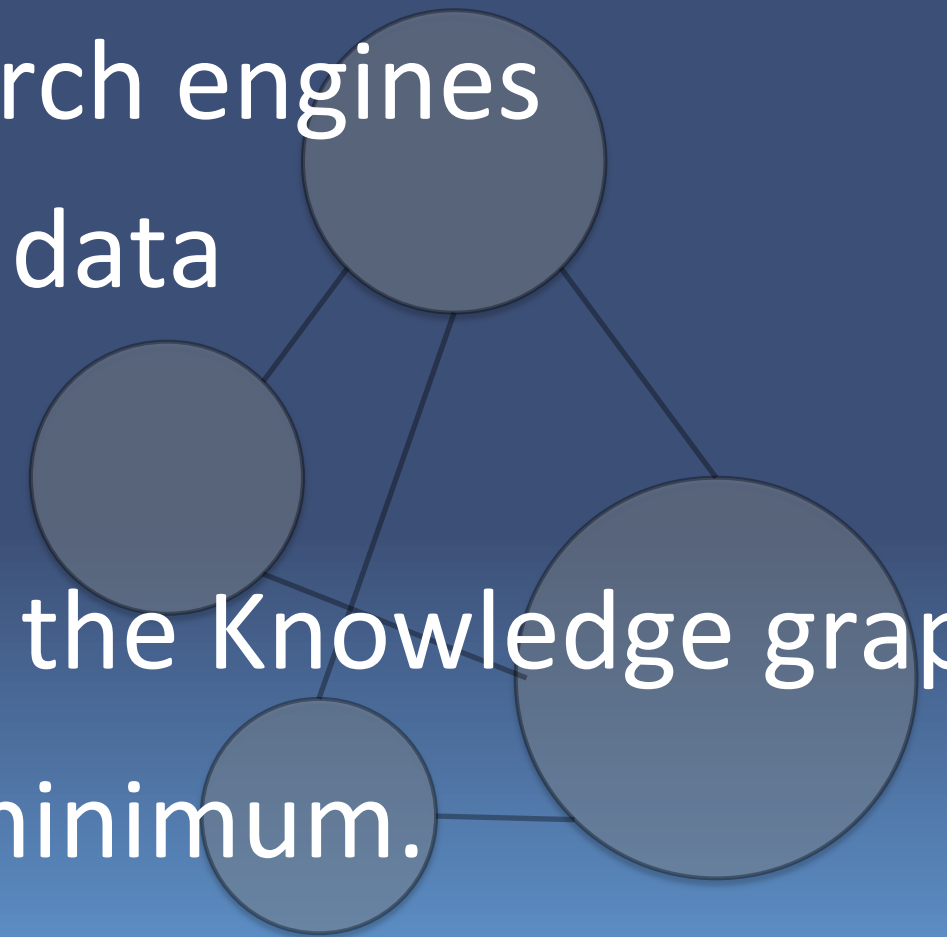
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 - Schema.org enrichment of BIBFRAME
- Schema.org as the 'lingua franca' vocabulary of the Knowledge graph
 - All entities described using Schema.org as a minimum.

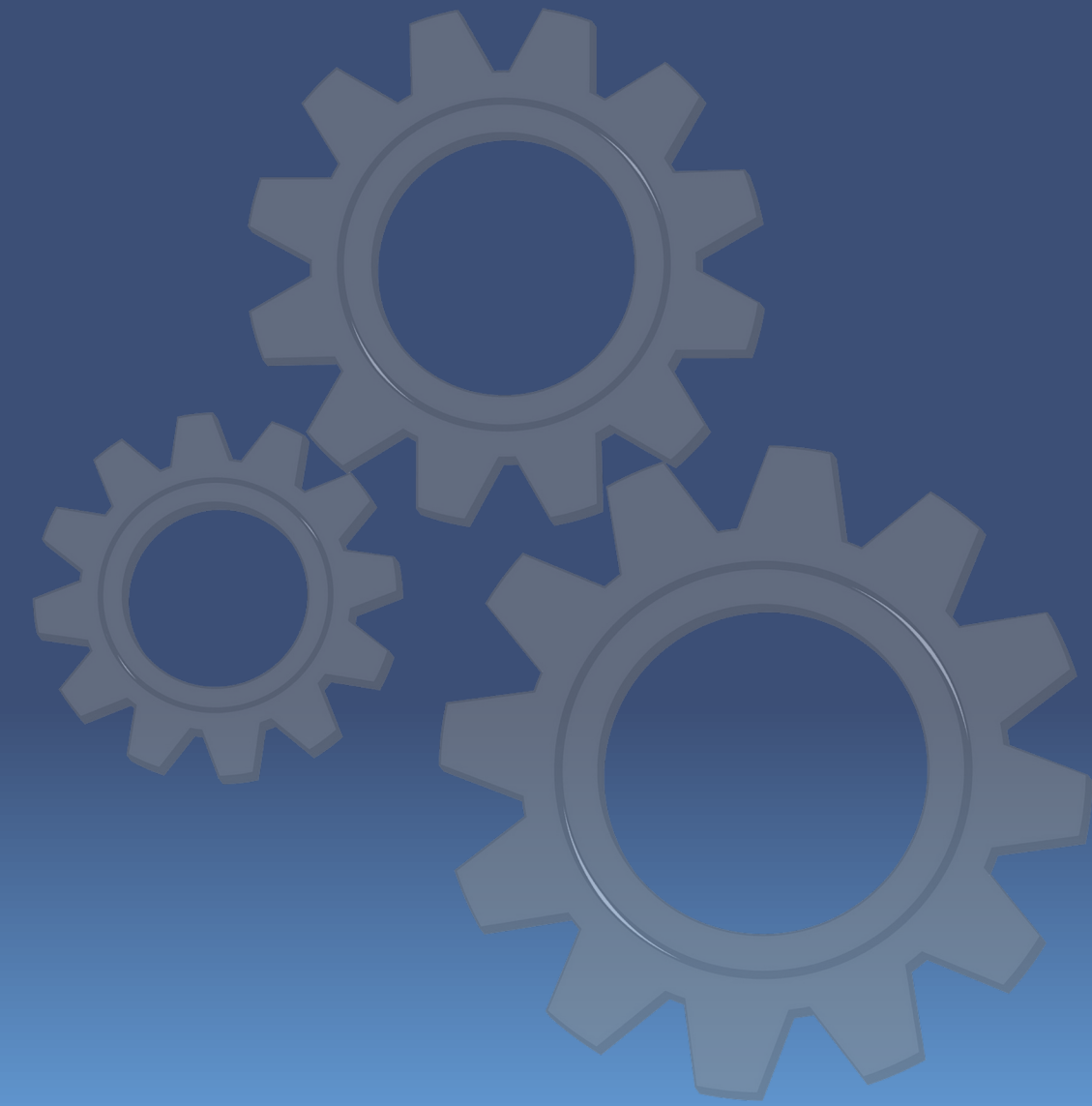


Data Data Data!

Data Source	Source Records	Entity Count	Update Frequency
ILS	1.4m	56.8m	Daily
CMS	82k	228k	Weekly
NAS	1.6m	6.7m	Monthly
TTE	3k	317k	Monthly
	3.1m	70.4m	

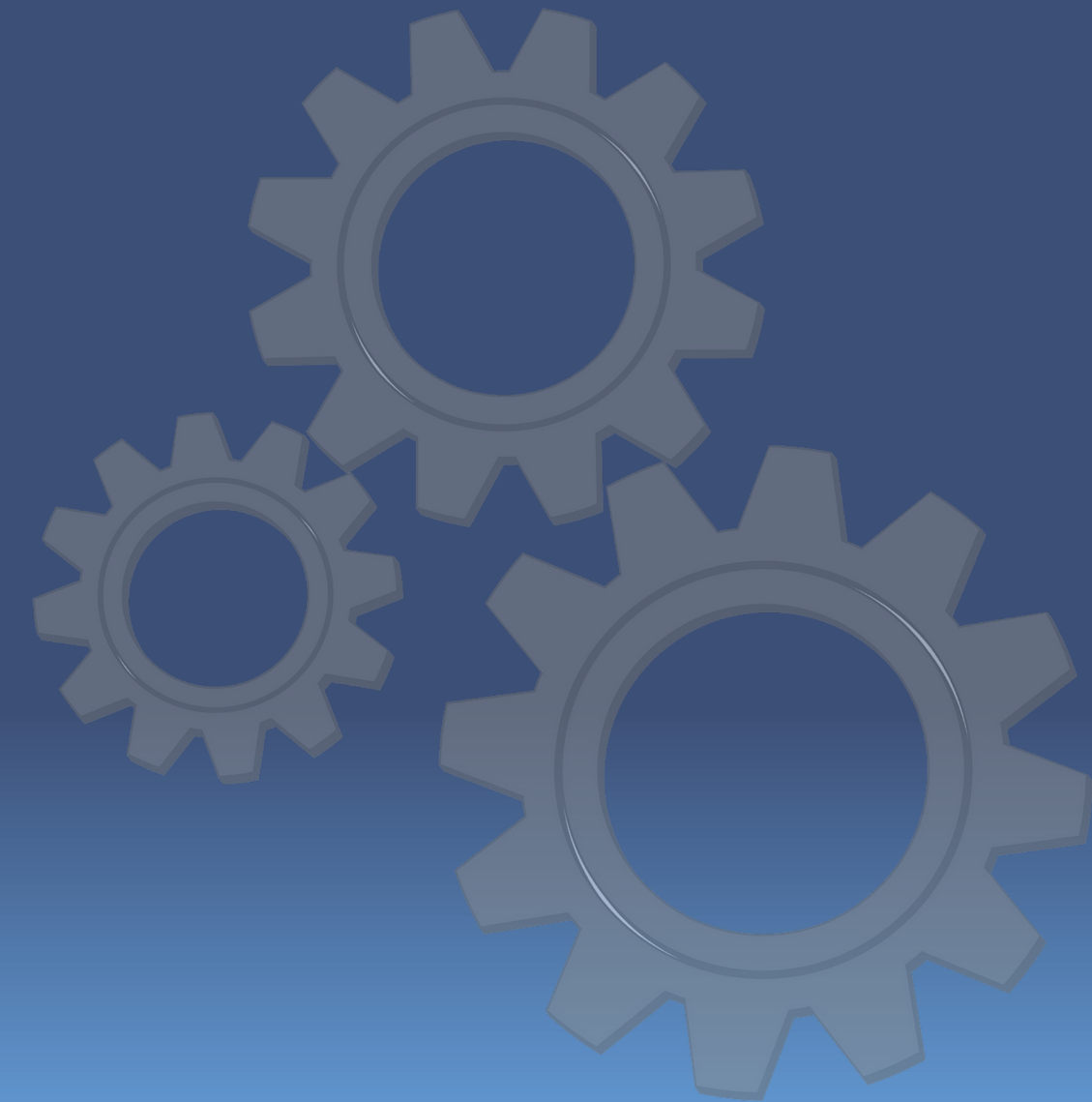
Data Ingest Pipelines – ILS

- Source data in MARC-XML files



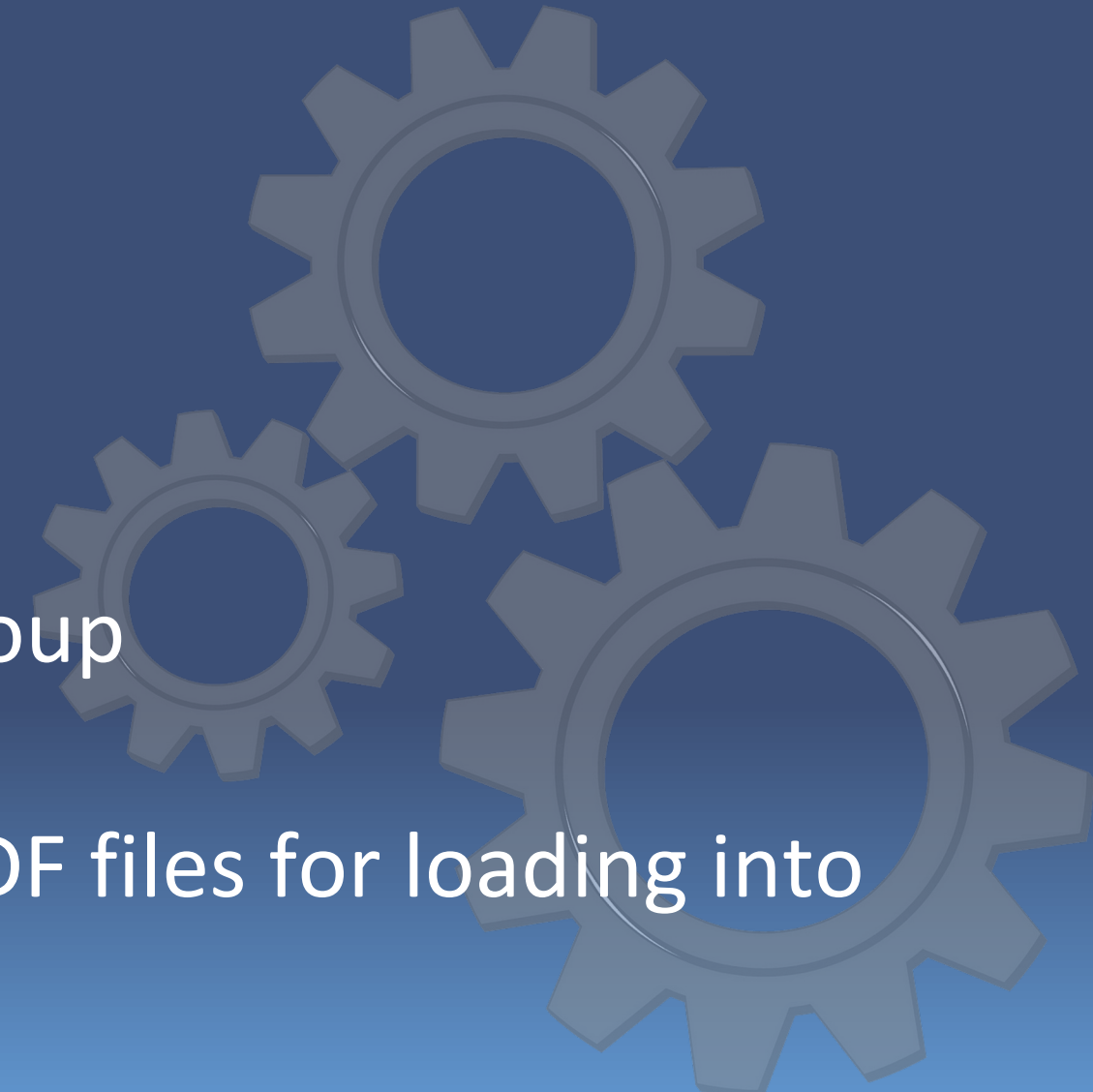
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- Step 1: marc2bibframe2 scripts
 - Open source – shared by Library of Congress
 - “standard” approach
 - Output BIBFRAME as individual RDF-XML files



Data Ingest Pipelines – ILS

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- Step 1: marc2bibframe2 scripts
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 - “standard” approach
 - Output BIBFRAME as individual RDF-XML files
- Step 2: bibframe2schema.org script
 - Open source – Bibframe2Schema.org Community Group
 - SPARQL-based script
 - Output Schema.org enriched individual BIBFRAME RDF files for loading into Knowledge graph triplestore



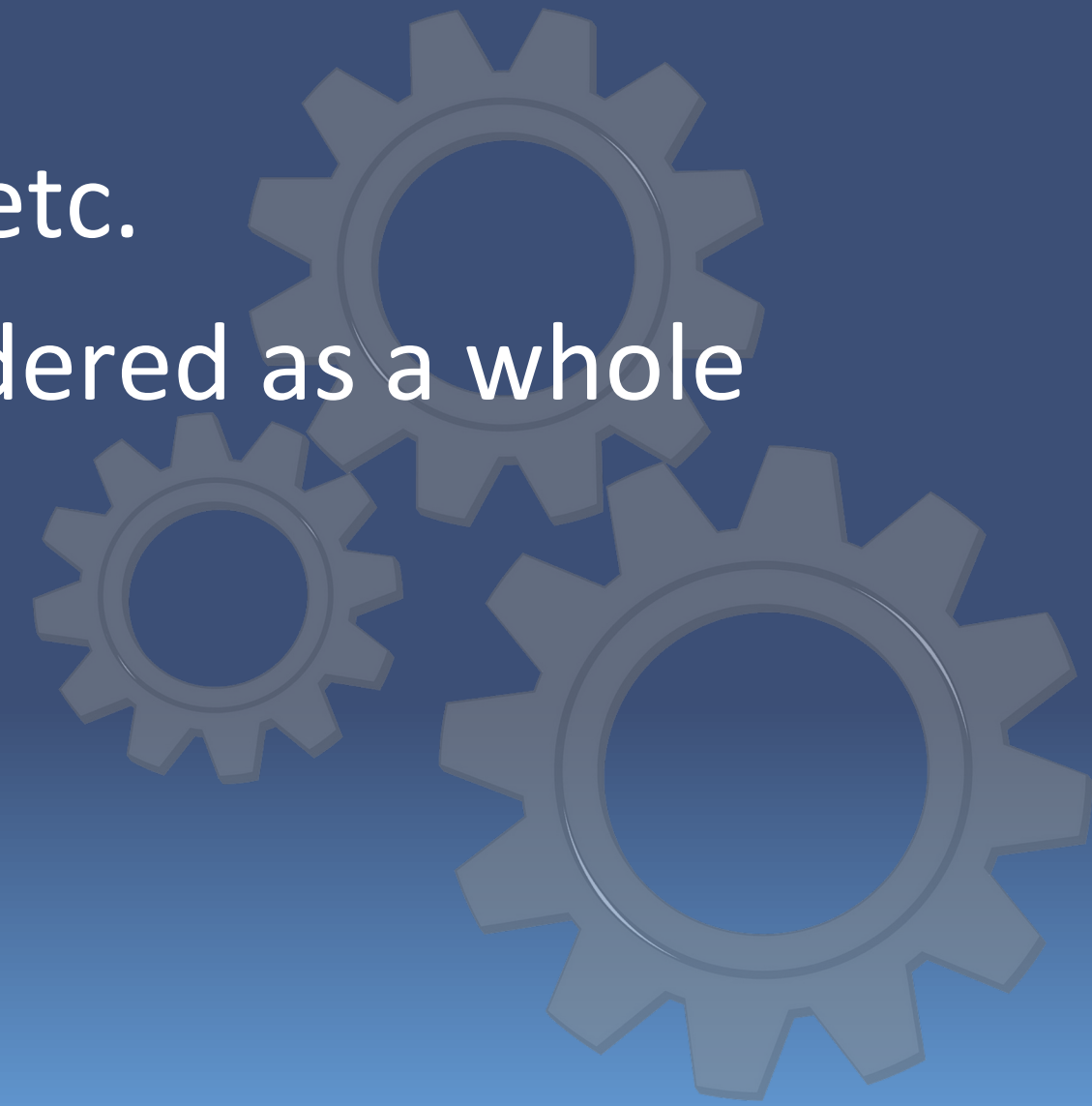
Data Ingestion Pipelines – TTE (Authorities)

- Source data in bespoke CSV format
- Exported in collection-based files
 - People, Places, organisations, time periods, etc.

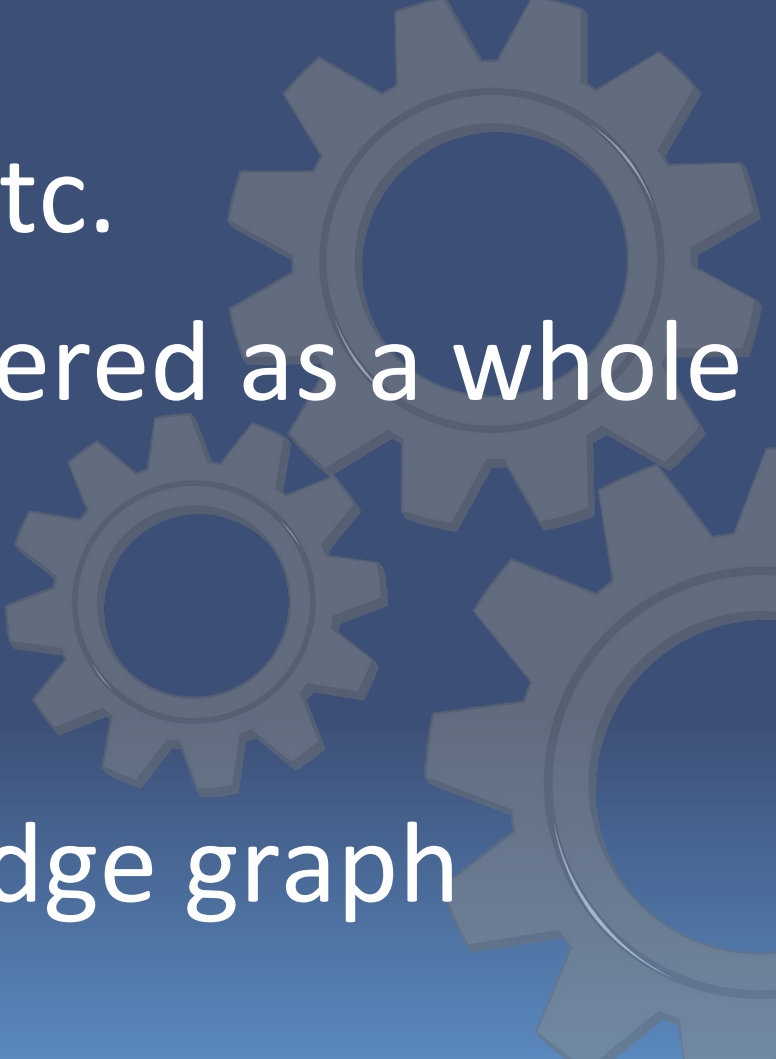


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- Interrelated references so needed to be considered as a whole



Data Ingestion Pipelines – TTE (Authorities)

- Source data in bespoke CSV format
 - Exported in collection-based files
 - People, Places, organisations, time periods, etc.
 - Interrelated references so needed to be considered as a whole
 - Bespoke python script
 - Creating Schema.org entity descriptions
 - Output RDF format file for loading into Knowledge graph triplestore
- 

Data Ingestion Pipelines – NAS & CMS

- Source data in DC-XML files



Data Ingestion Pipelines – NAS & CMS

- Source data in DC-XML files
- Step 1: DC-XML to DC-Terms RDF
 - Bespoke XSLT script to translate from DC record to DCT-RDF



Data Ingestion Pipelines – NAS & CMS

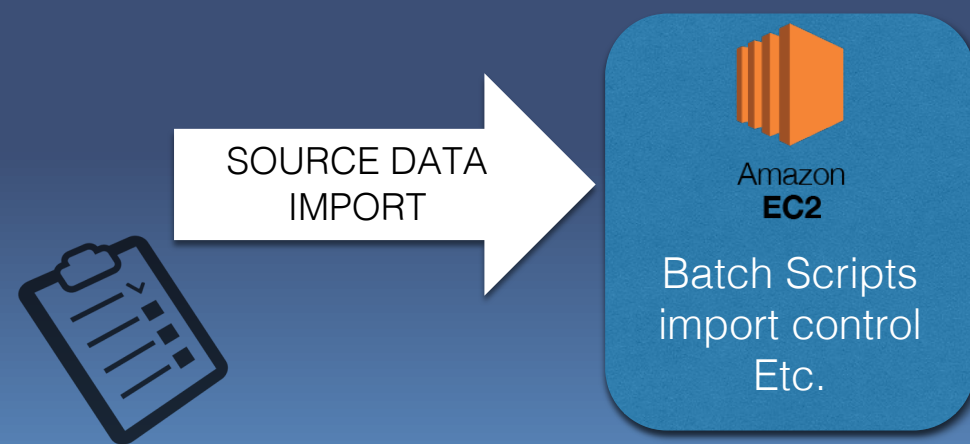
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 - Lookup identified values against TTE entities in Knowledge graph
 - use URI if matched

Data Ingestion Pipelines – NAS & CMS

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- Step 2: TTE lookup
 - Lookup identified values against TTE entities in Knowledge graph
 - use URI if matched
- Step 3: Schema.org entity creation
 - SPARQL script create schema representation of DCT entities
- Output individual RDF format files for loading into Knowledge graph

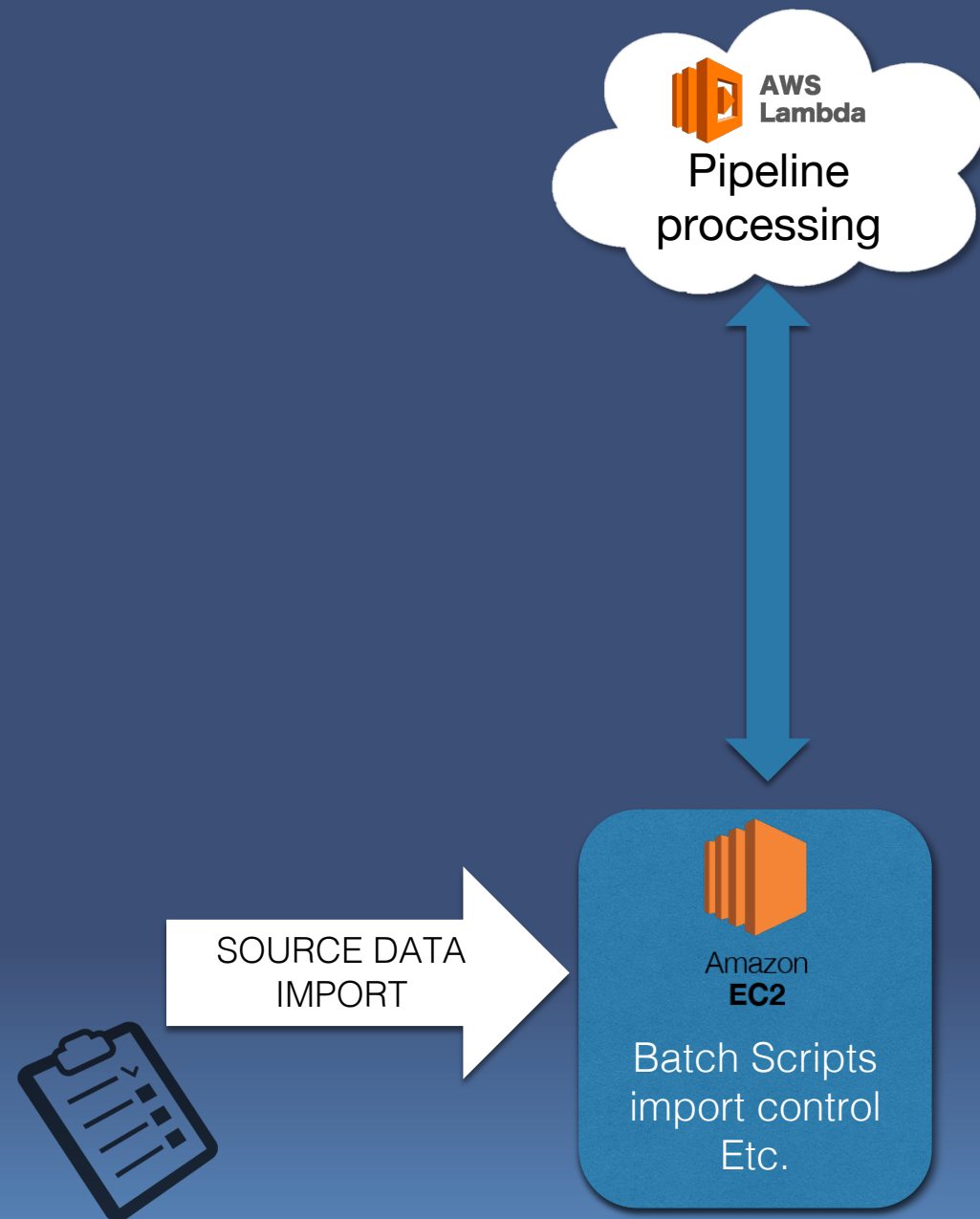
Technical Architecture (simplified)

Hosted on Amazon Web Services



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Hosted on Amazon Web Services



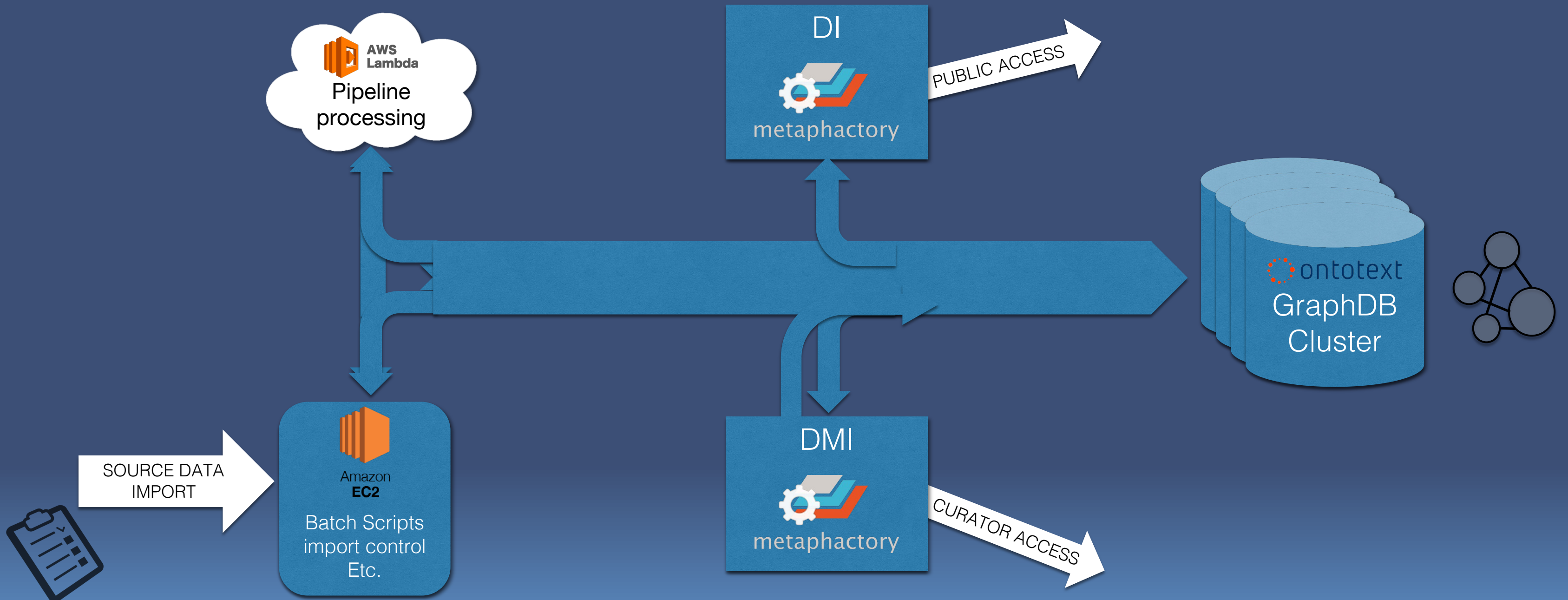
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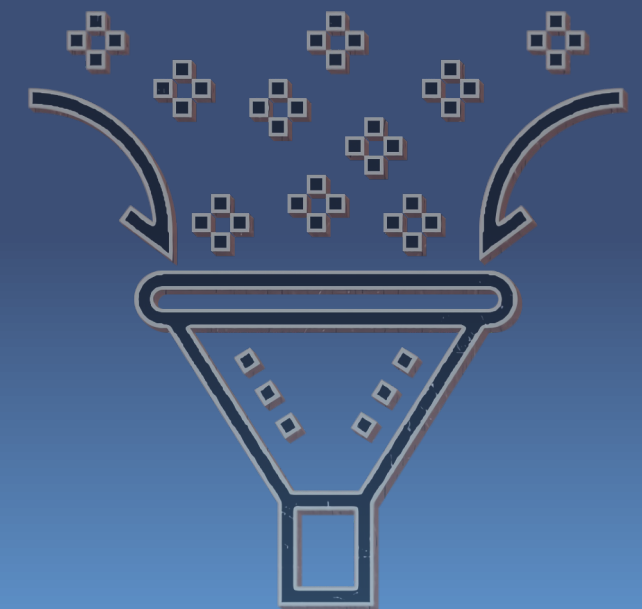
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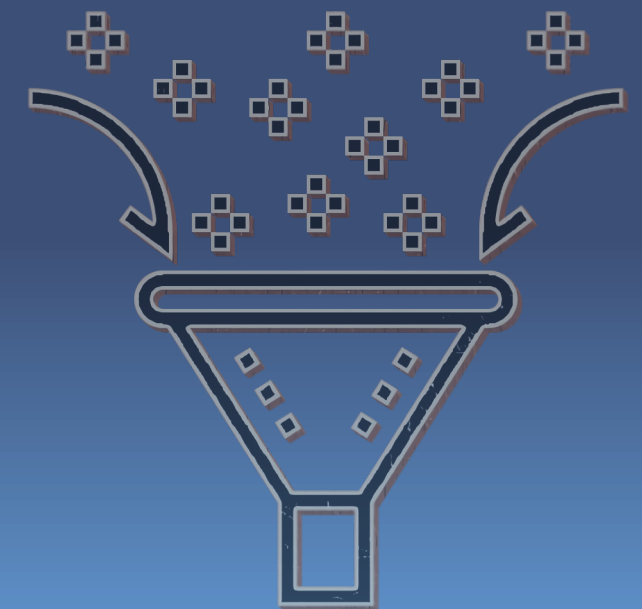
A need for entity reconciliation

- Lots (and lots and lots) of source entities – 70.4 million entities



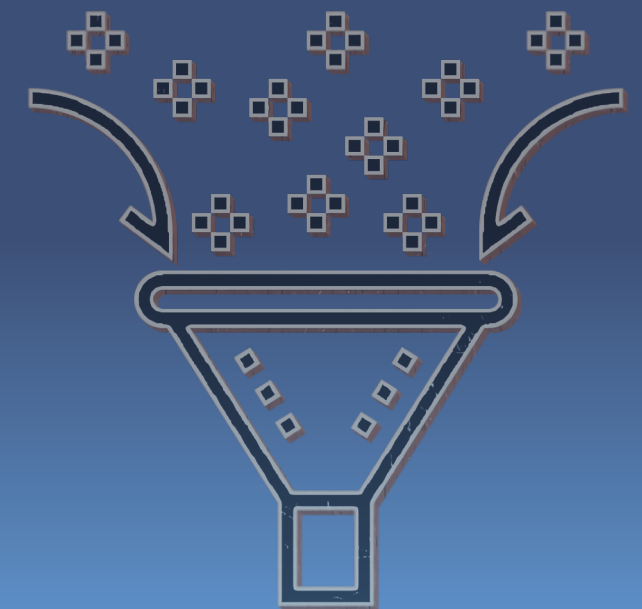
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 - Lee, Kuan Yew – 1st Prime Minister of Singapore
 - 160 individual entities in ILS source data



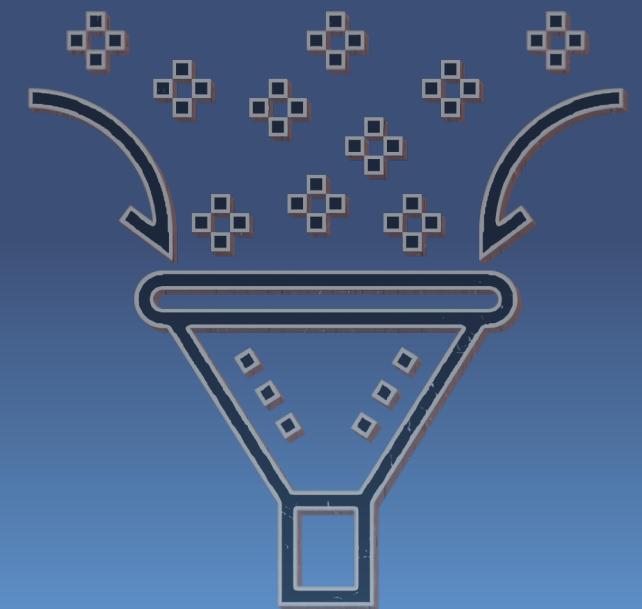
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 - Singapore Art Museum
 - Entities from source data
 - 21 CMS, 1 NAS, 66 ILS, 1 TTE



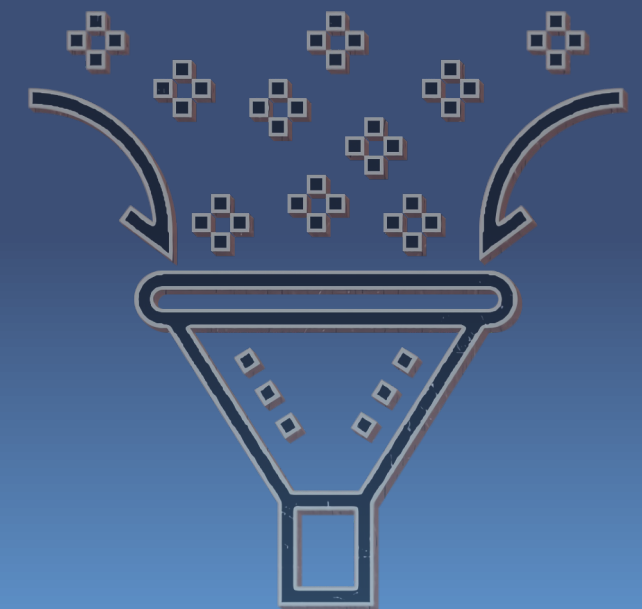
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 - Entities from source data
 - 21 CMS, 1 NAS, 66 ILS, 1 TTE
- Users only want 1 of each!



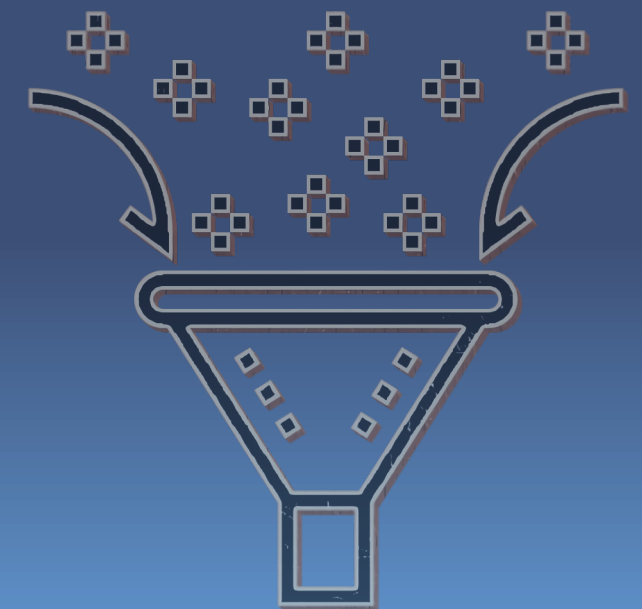
70.4_(million) into 6.1_(million) entities does go!

- We know that now - but how did we get there?



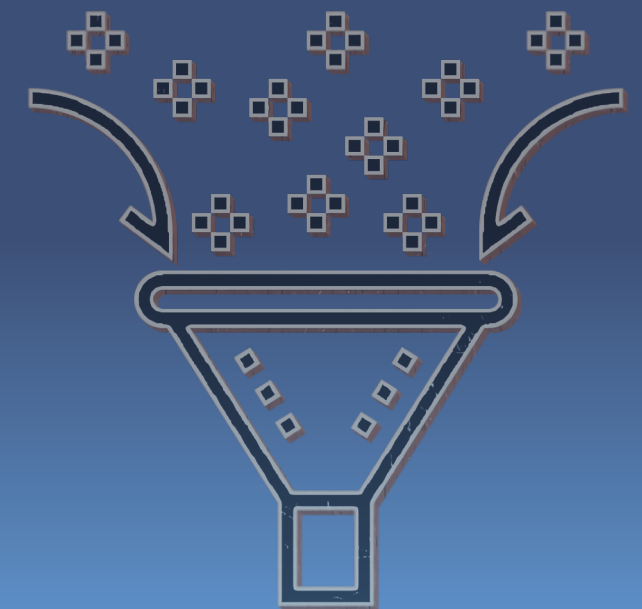
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 - Suppression of incorrect or 'private' attributes from display
 - Addition of attributes not in source data
 - Creating / breaking relationships between entities



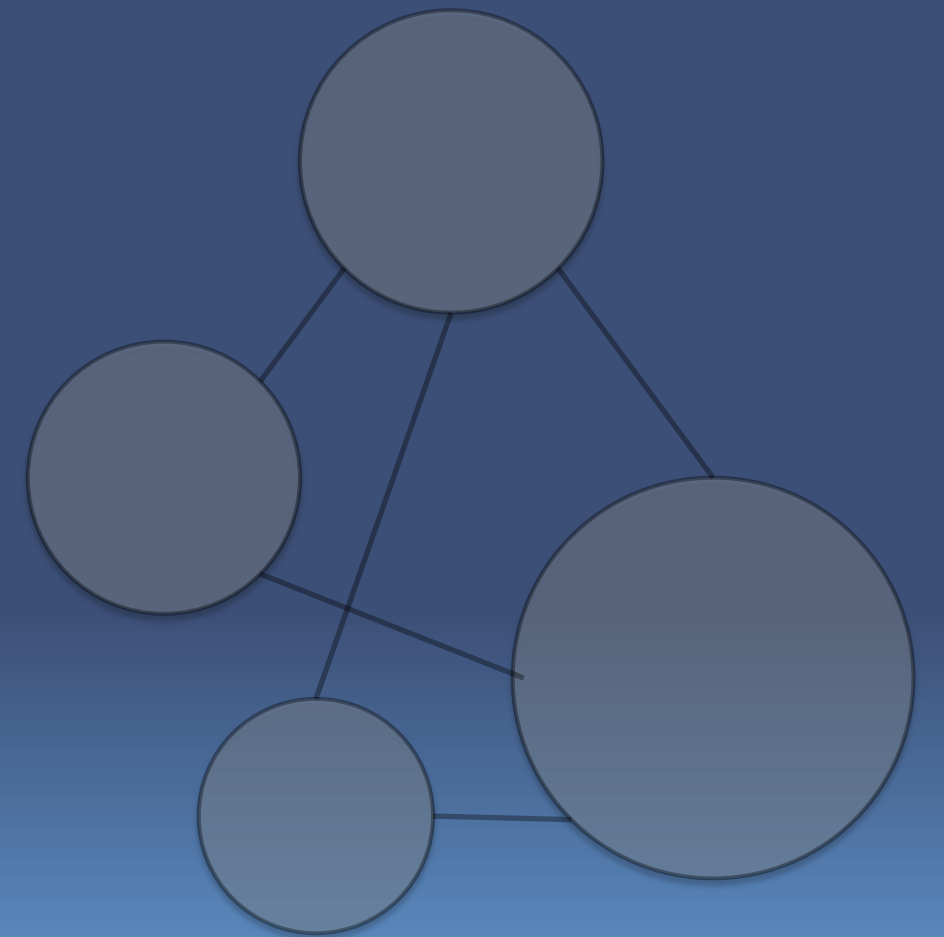
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 - Creating / breaking relationships between entities
- Near real-time updates



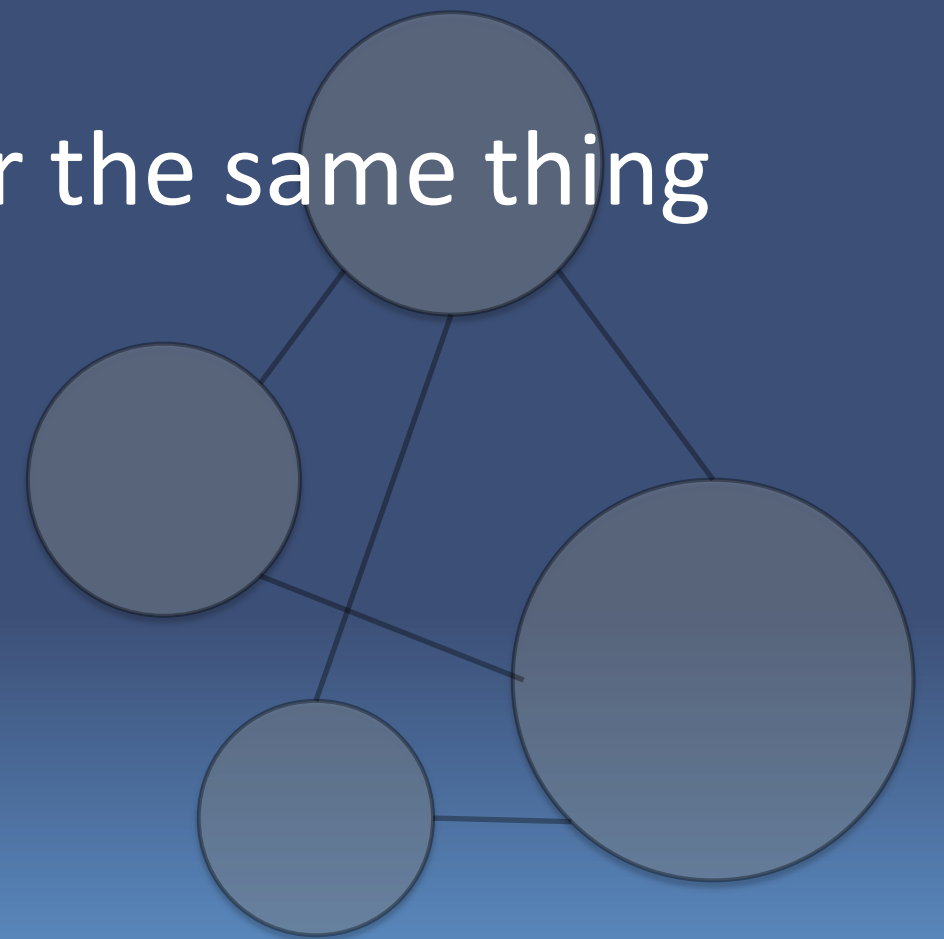
Adaptive Data Model Concepts

- **Source entitles**
 - Individual representation of source data



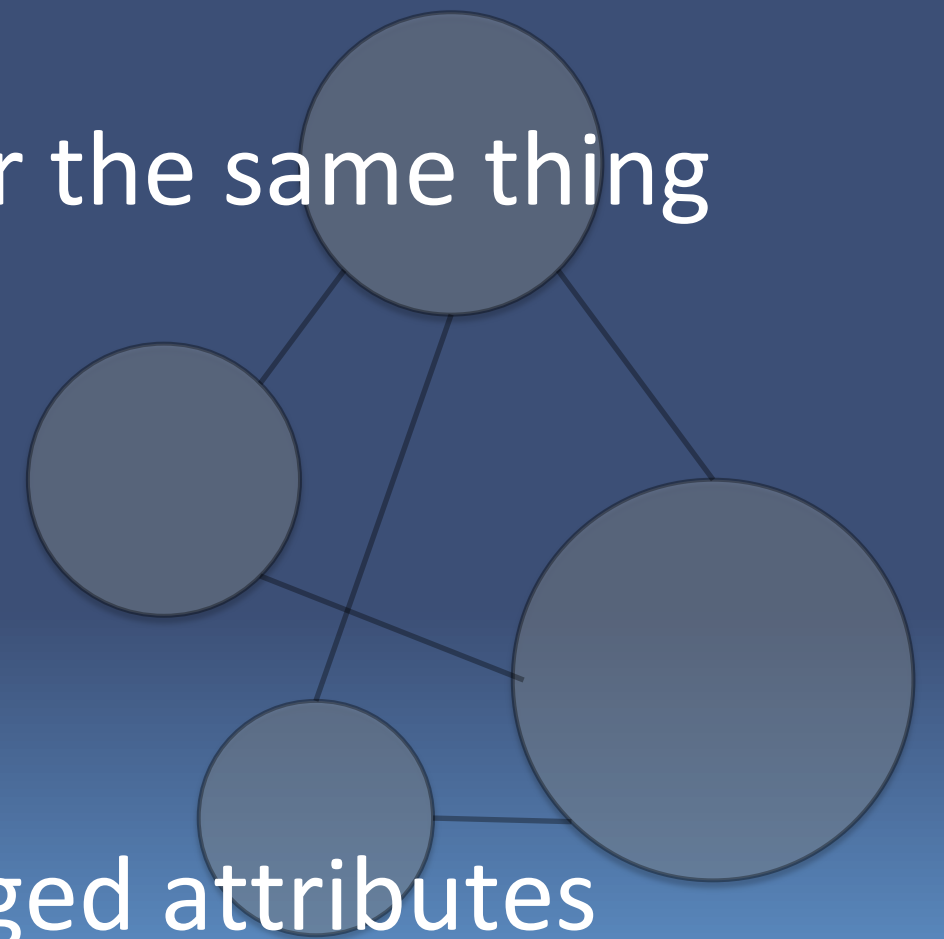
Adaptive Data Model Concepts

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- **Aggregation entities**
 - Tracking relationships between source entities for the same thing
 - No copying of attributes



Adaptive Data Model Concepts

- **Source entities**
 - Individual representation of source data
- **Aggregation entities**
 - Tracking relationships between source entities for the same thing
 - No copying of attributes
- **Primary Entities**
 - Searchable by users
 - Displayable to users
 - Consolidation of aggregated source data & managed attributes



Singapore Art Museum [NLB] x +

Not Secure | <https://13.212.72.150/resource/dmi-organization:7bff9657-de53-41d5-b8be-8df3f3ac3203?view=graph>

Edit Page

Singapore Art Museum
Agent, Jurisdiction, Organ...

Save ↻ ↺ 🔍 🔍 + Pathfinder * Force layout - Export -

Singapore Art Museum [NLB] x +

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Edit Page

Singapore Art Museum
Agent, Jurisdiction, Organ...

Connections

copyrightHolder	1	>
creator	1	>
identifier	3	>
inDefinedTermSet	1	>
isAggregatedBy	4	>
producer	1	>
provider	26	>

Save | Pathfinder | Force layout | Export

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Edit Page

```
graph LR; A[7bff9657-de53-41d5-... Aggregation] -- isAggregatedBy --> B[Singapore Art Museum Agent, Jurisdiction, Organ...]; C[7bff9657-de53-41d5-... Aggregation] -- isAggregatedBy --> B; D[7bff9657-de53-41d5-... Aggregation] -- isAggregatedBy --> B; E[7bff9657-de53-41d5-... Aggregation] -- isAggregatedBy --> B;
```

7bff9657-de53-41d5-... Aggregation

isAggregatedBy

Singapore Art Museum
Agent, Jurisdiction, Organ...

7bff9657-de53-41d5-... Aggregation

isAggregatedBy

7bff9657-de53-41d5-... Aggregation

isAggregatedBy

7bff9657-de53-41d5-... Aggregation

7bff9657-de53-41d5-... Aggregation

Save

Pathfinder

Force layout

Export

Singapore Art Museum [NLB] x +

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```

Connections X

Connections / aggregates (out)

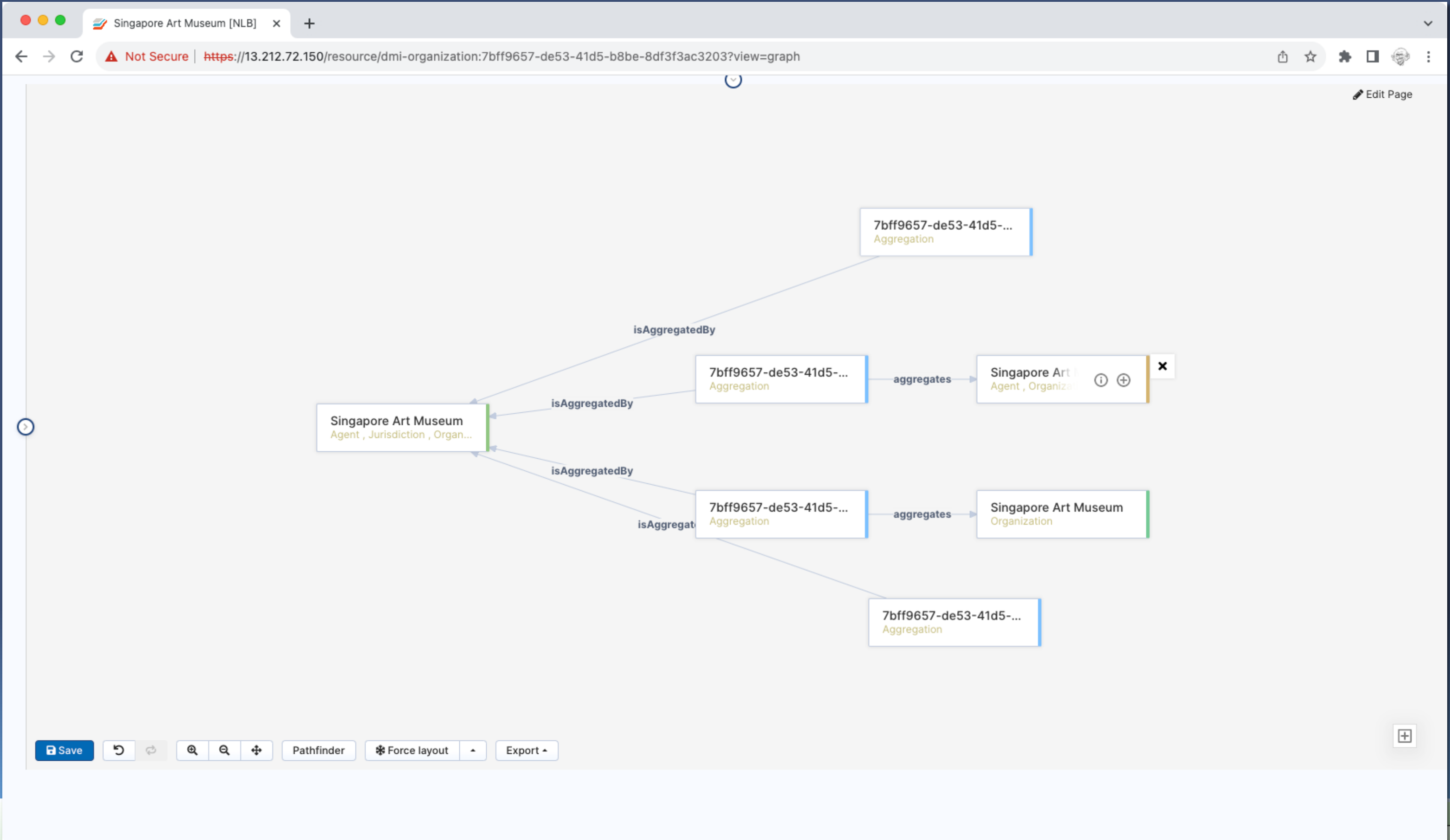
Search for...

Select All

- Singapore Art Museum

0 of 1 Add all

Save | Refresh | Search | Pathfinder | Force layout | Export



Singapore Art Museum [NLB] x +

Not Secure | <https://13.212.72.150/resource/dmi-organization:7bff9657-de53-41d5-b8be-8df3f3ac3203?view=graph>

Edit Page

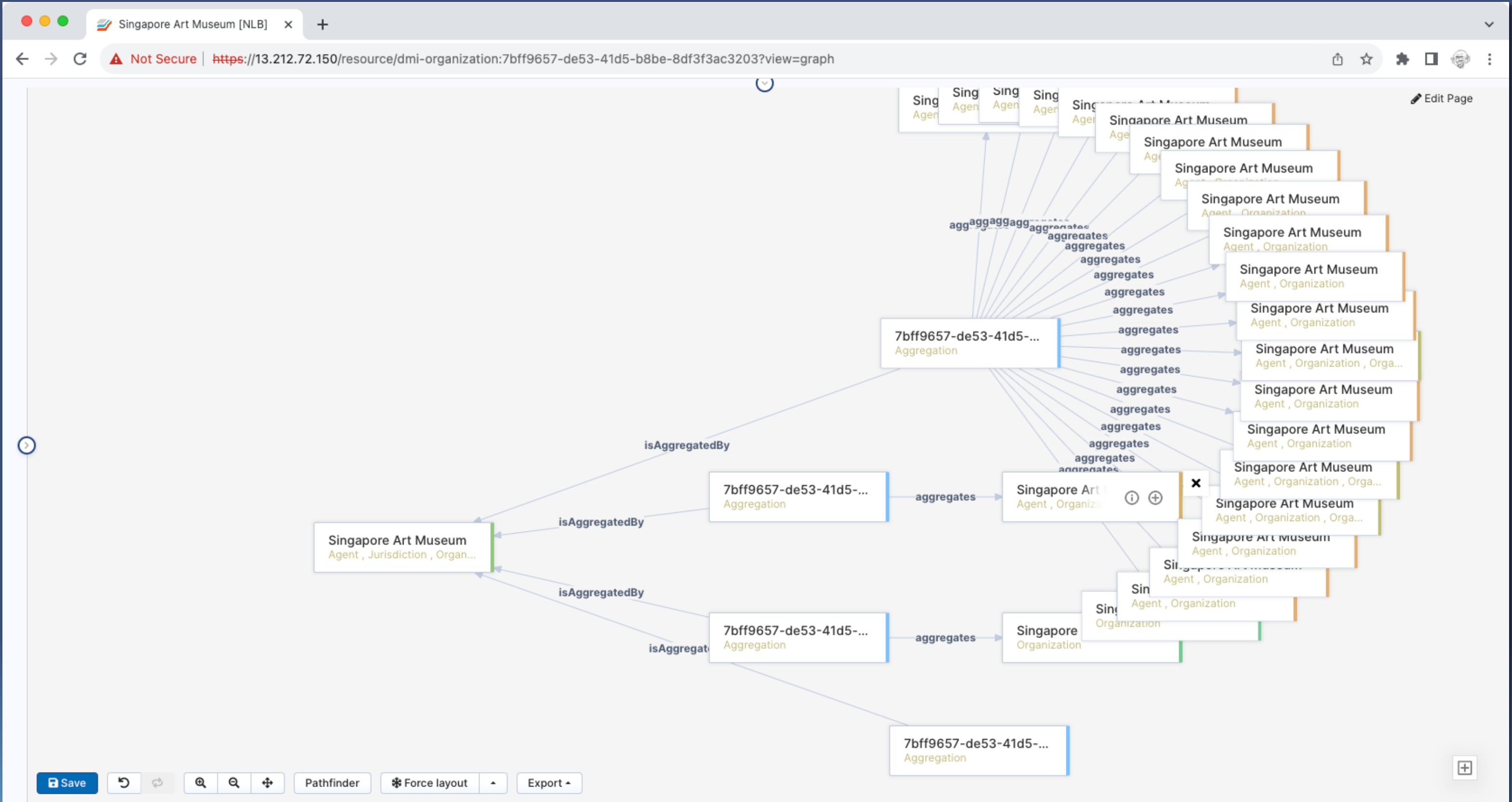
Connections

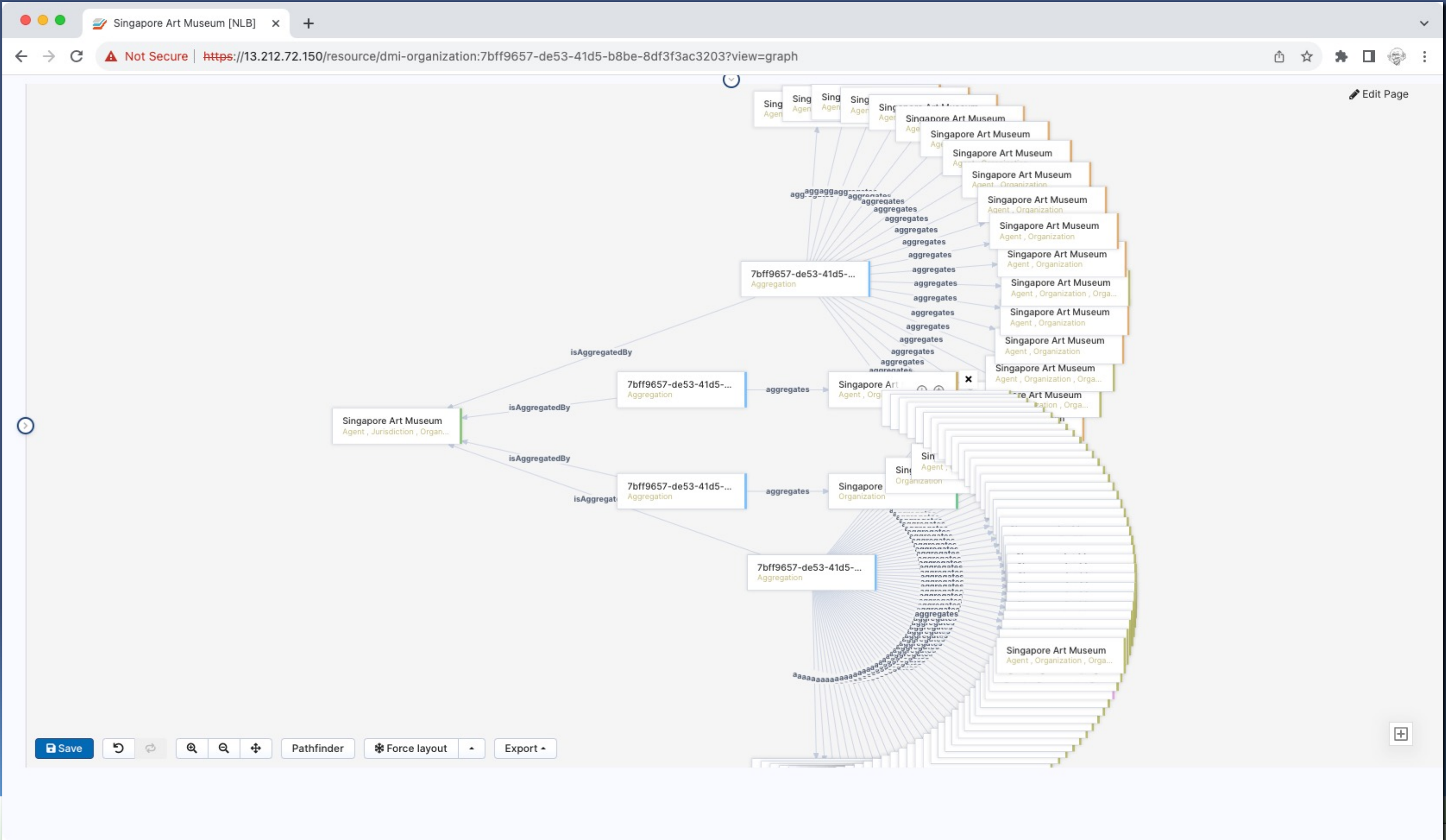
Search for...

All 23

- aggregates 21
- isAggregatedBy 1
- type 1

Save | Pathfinder | Force layout | Export





Entity Matching

- Candidate matches based on schema:names
 - Lucene indexes matching



Entity Matching

- Candidate matches based on schema:names
 - Lucene indexes matching
 - Levenshtein similarity refined



Entity Matching

- Candidate matches based on schema:names
 - Lucene indexes matching
 - Levenshtein similarity refined
 - Same entity type



Entity Matching

- Candidate matches based on schema:names
 - Lucene indexes matching
 - Levenshtein similarity refined
 - Same entity type
 - Entity type specific rules eg:
 - Work: name + creator / contributor / author / sameAs



Entity Matching

- Candidate matches based on schema:names
 - Lucene indexes matching
 - Levenshtein similarity refined
 - Same entity type
 - Entity type specific rules eg:
 - Work: name + creator / contributor / author / sameAs
 - Person: name + birthDate / deathDate / sameAs

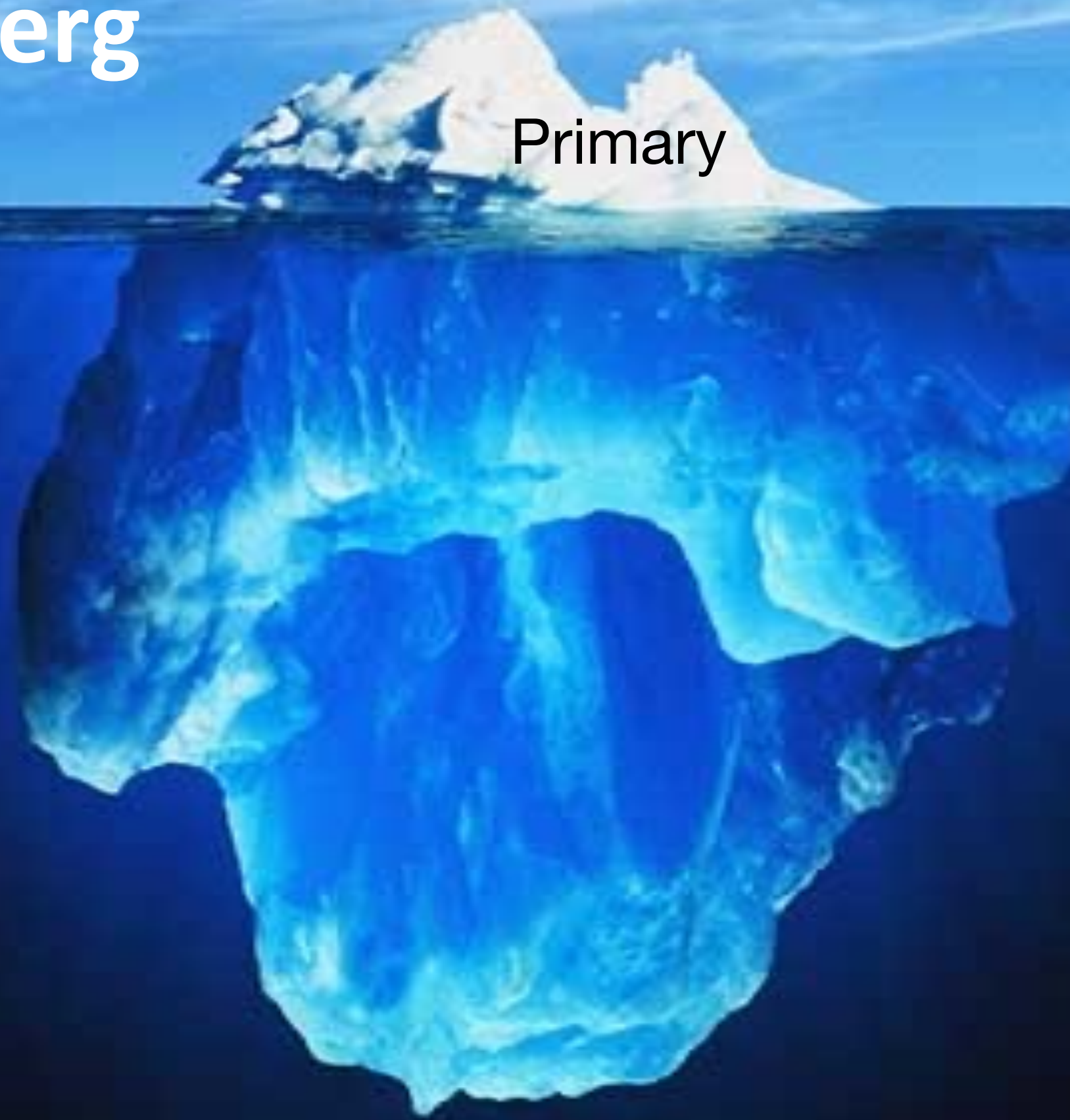


The entity iceberg



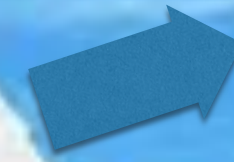
The entity iceberg

Primary



The entity iceberg

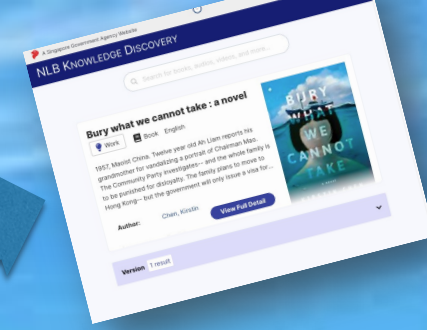
Primary



Discovery

The entity iceberg

Primary

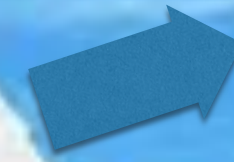


Discovery

Aggregation

The entity iceberg

Primary



Discovery

Aggregation

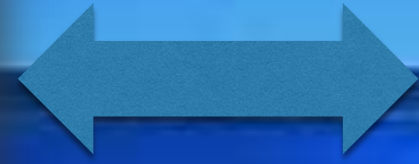
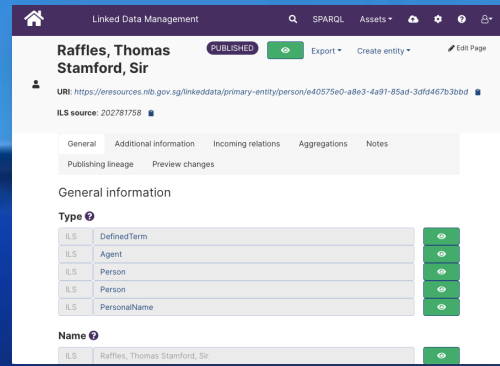
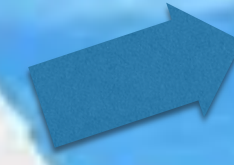
Source

Ingestion
Pipelines

The entity iceberg

Discovery

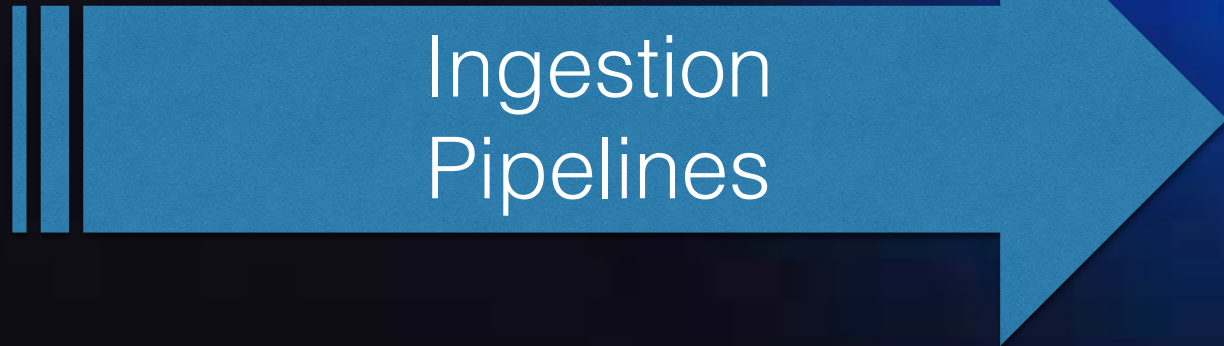
Primary



Management

Aggregation

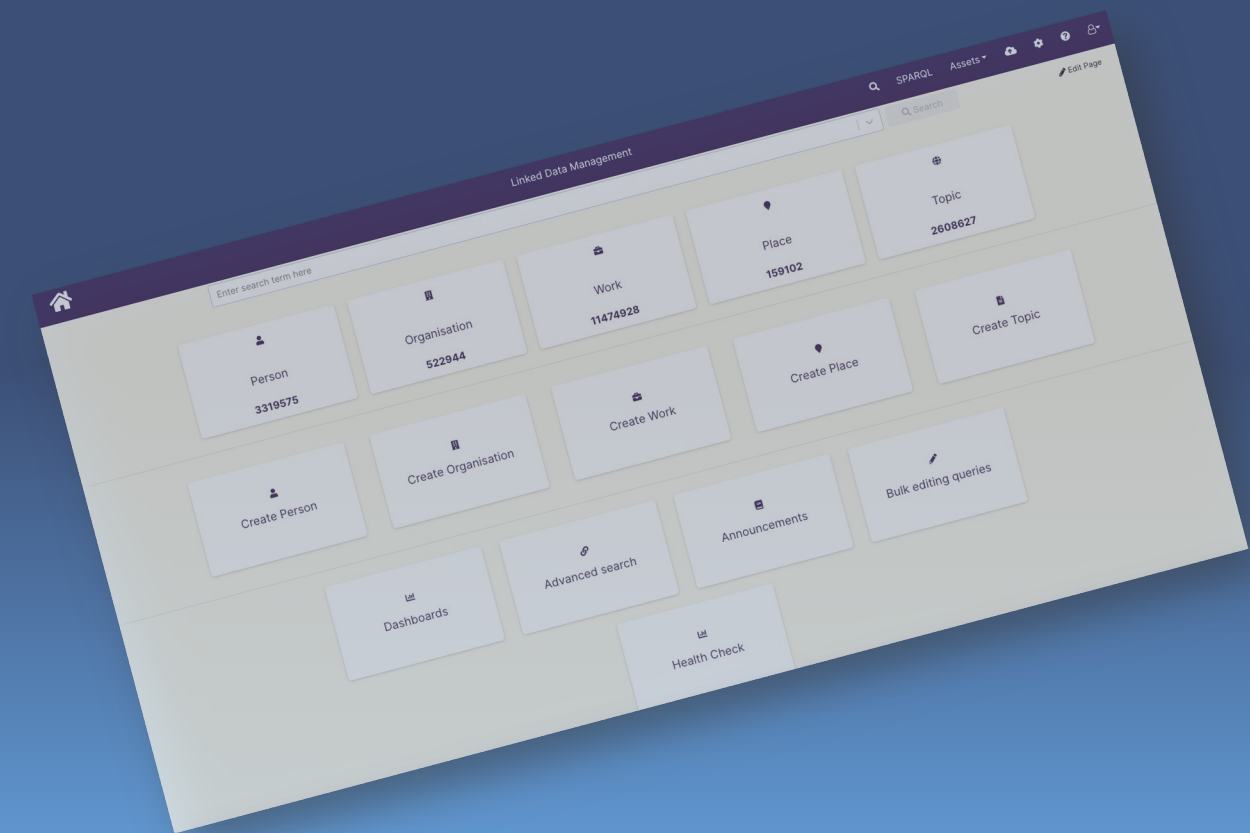
Source



Ingestion Pipelines

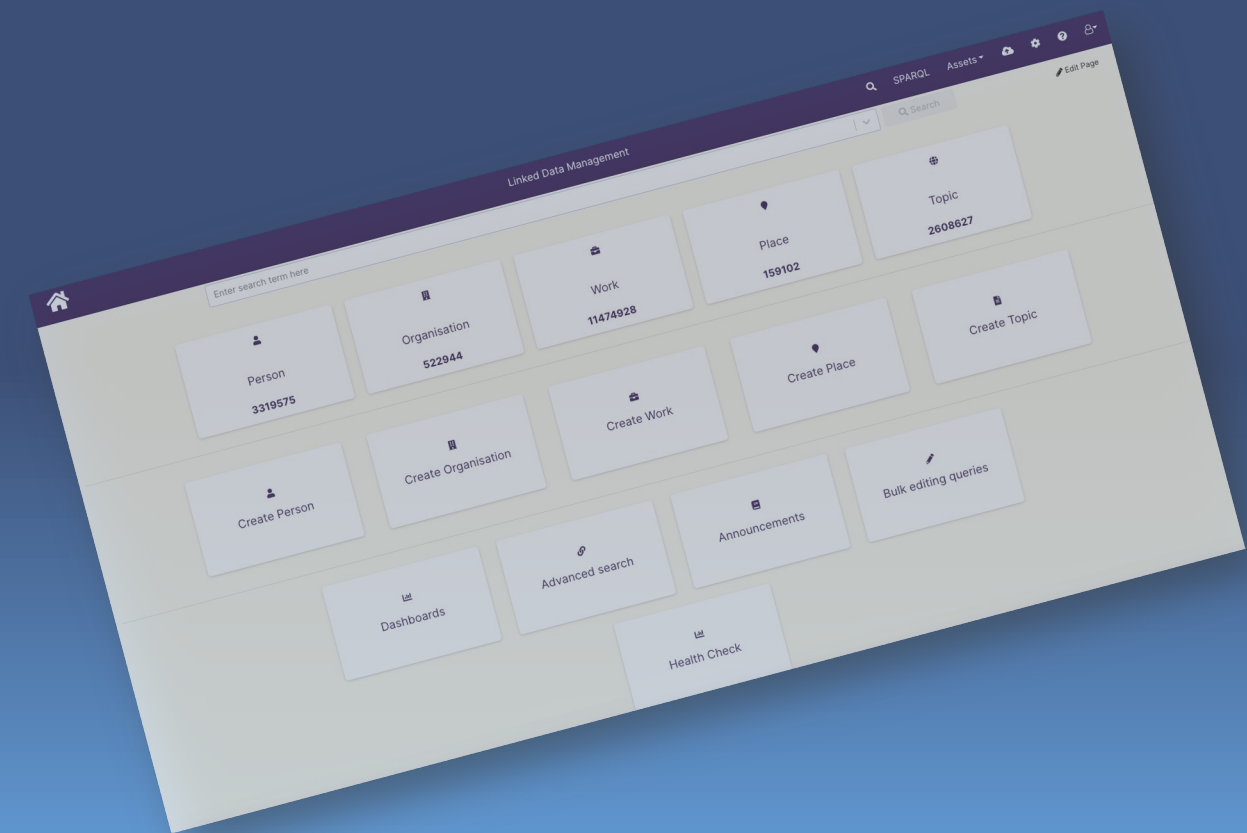
Data Management Interface

- Rapidly developed – easily modified



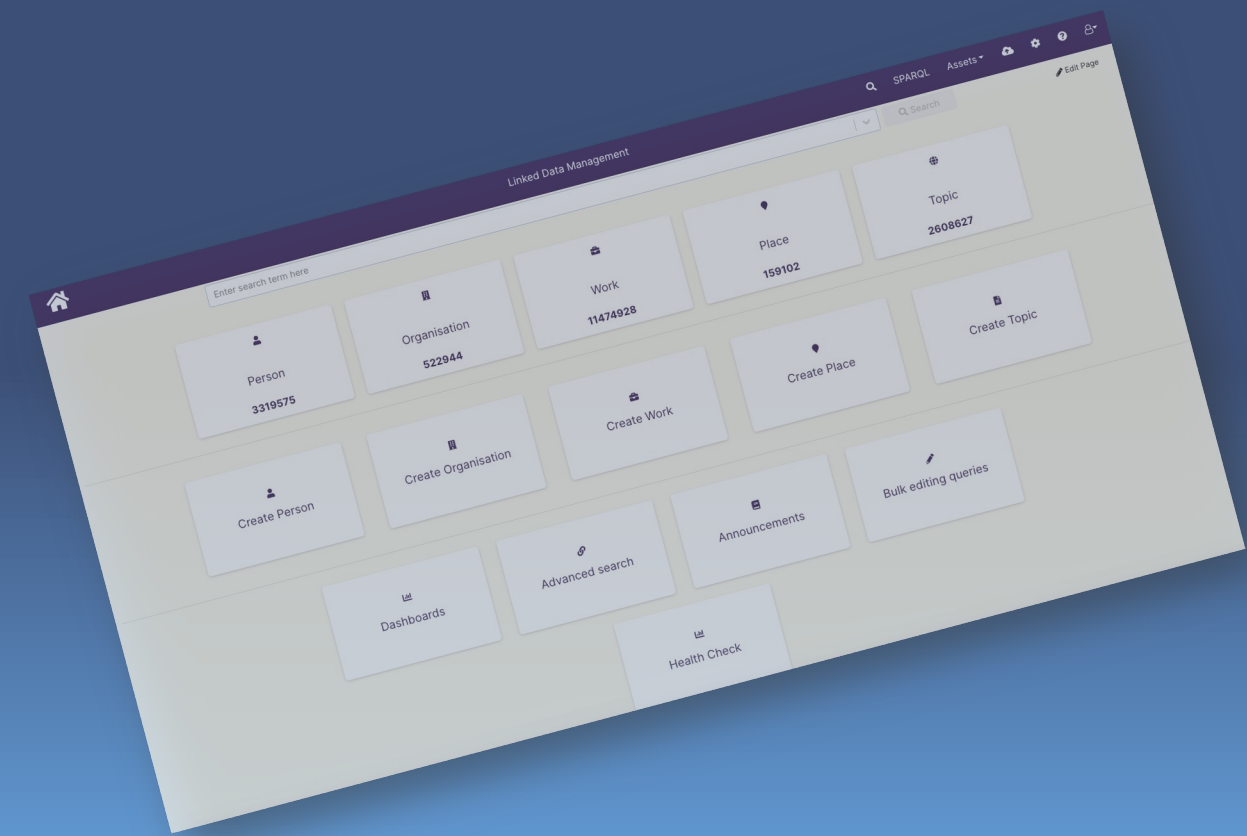
Data Management Interface

- Rapidly developed – easily modified
- Using mataphactory's semantic visual interface



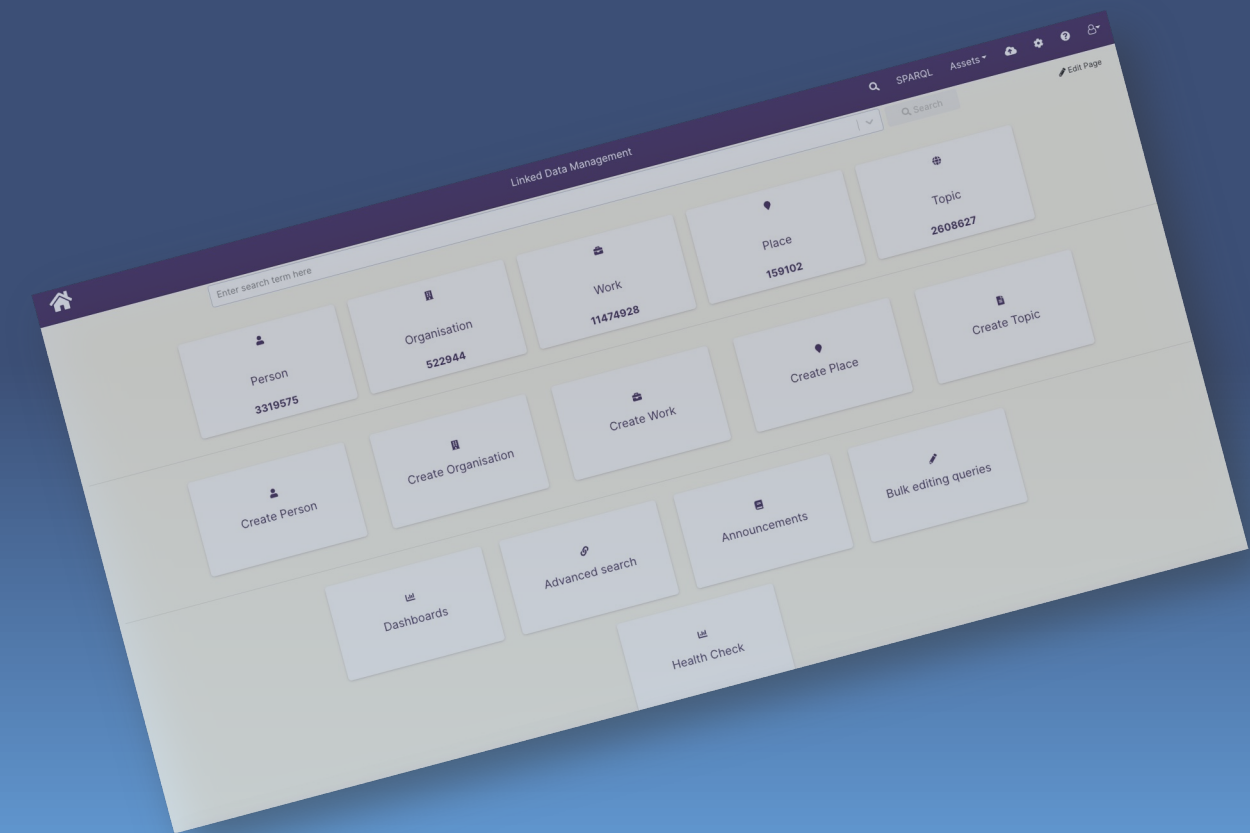
Data Management Interface

- Rapidly developed – easily modified
- Using mataphactory's semantic visual interface
- A collaboration environment for data curators



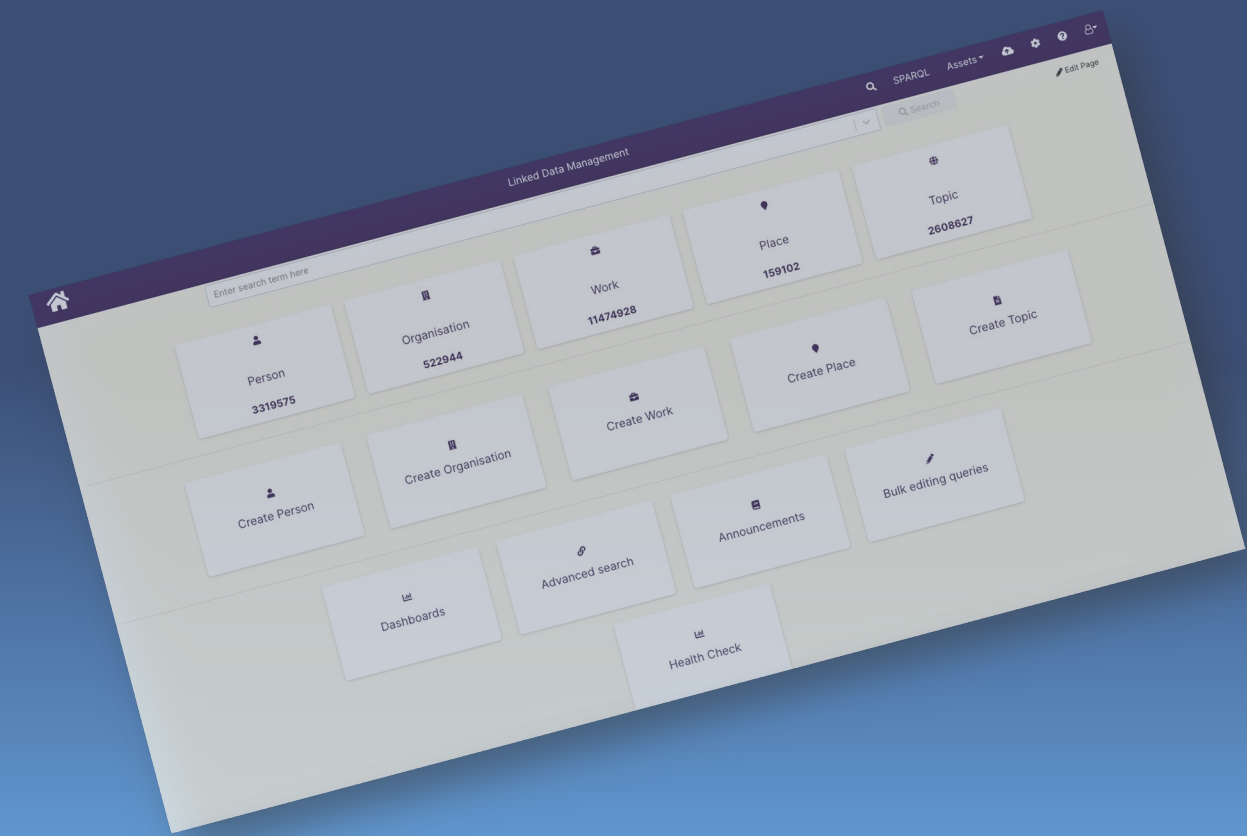
Data Management Interface

- Rapidly developed – easily modified
- Using mataphactory's semantic visual interface
- A collaboration environment for data curators
- Pre-publish entity management



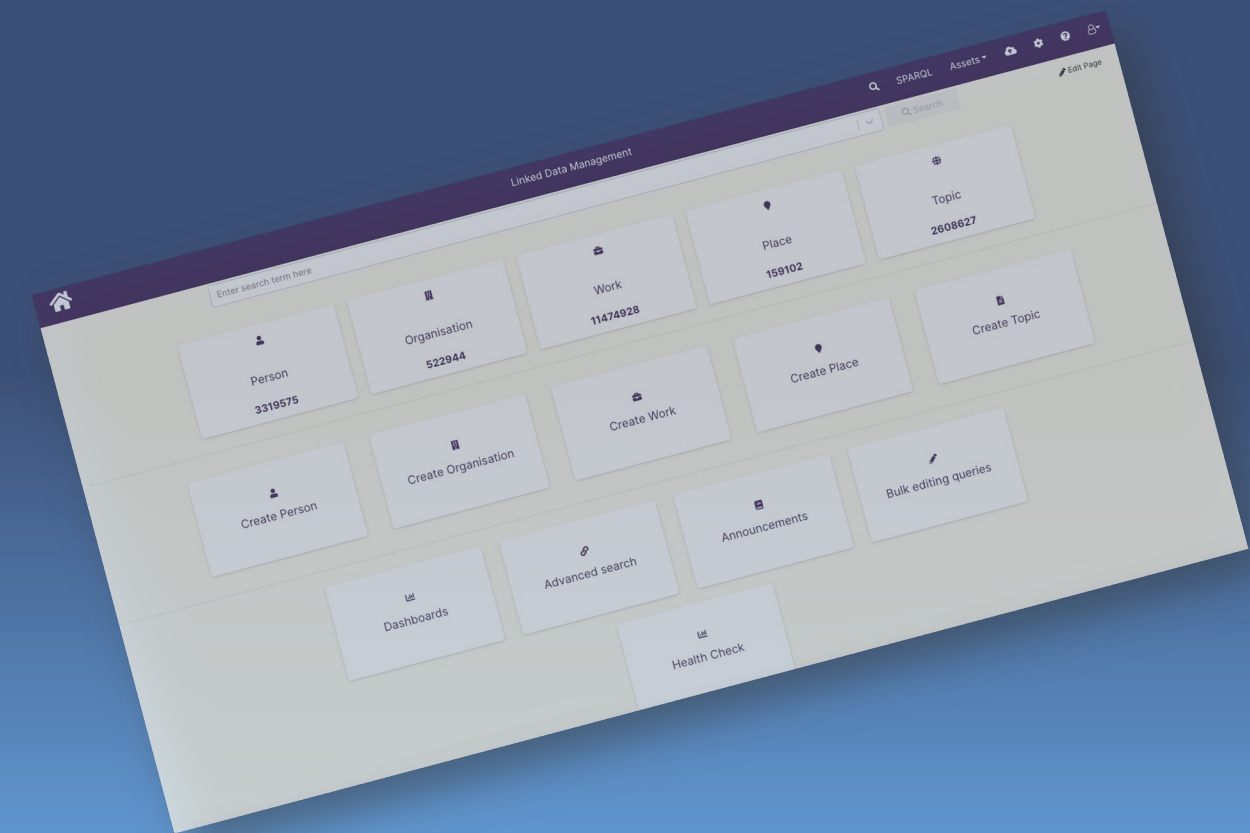
Data Management Interface

- Rapidly developed – easily modified
- Using mataphactory's semantic visual interface
- A collaboration environment for data curators
- Pre-publish entity management
- Search & discovery – emulates DI



Data Management Interface

- Rapidly developed – easily modified
- Using mataphactory's semantic visual interface
- A collaboration environment for data curators
- Pre-publish entity management
- Search & discovery – emulates DI
- Dashboard view
- Entity management / Creation





Thomas Raffles

Search for "Thomas Raffles"

Person	Organisation	Work	Place
1106184	172756	3725329	53053

Topic

856293

Create Person

Create Organisation

Create Work

Create Place

Create Topic



Edit Page

Thomas Raffles



Search

Search Results: Thomas Raffles



Person 5



Organisation 0



Work 179



Place 0



Topic 115

RESET

Filters

Clear All

Type

Alumni Of

Affiliation

Nationality

Birth Date

Occupation

Create Person

Export

Reset selection

Raffles, Thomas, 1788-1863

DefinedTerm Person PersonalName Thing



Raffles, Thomas Stamford, Sir

DefinedTerm Person PersonalName Thing



Raffles, Thomas Stamford, Sir

DefinedTerm Person PersonalName Thing



Colonial administrator

British colonial administrator best known as the founder of modern Singapore. He was Lieutenant-Governor of British Java (1811-1815) and Governor-General of Bencoolen (1817-1822). Raffles first arrived in Singapore on 29 January 1819, and by 6 February 1819 had signed a treaty and raised the Union Jack on the island. Among his other contributions was the establishment of the Singapore Institution (later known as Raffles Institution), and the Singapore Library (now known as the National Library) which was established within the Singapore Institution.

Raffles, Thomas Stamford





Edit Page

Thomas Raffles [x] [v]

Search

Search Results: Thomas Raffles

Person 5 Organisation 0 Work 179 Place 0 Topic 115 [RESET]

- Filters** [Clear All]
- > Type
 - > Alumni Of
 - > Affiliation
 - > Nationality
 - > Birth Date
 - > Occupation

[+ Create Person] [Export] [Reset selection]

- Raffles, Thomas, 1788-1863** [edit] [info]
 - DefinedTerm Person PersonalName Thing
- Raffles, Thomas Stamford, Sir** [edit] [info]
 - DefinedTerm Person PersonalName Thing
- Raffles, Thomas Stamford, Sir** [edit] [info]
 - DefinedTerm Person PersonalName Thing

Colonial administrator

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Raffles, Thomas Stamford, Sir [x]

[link icon] Navigate to resource

URI: <https://eresources.nlb.gov.sg/linkeddata/primary-...>

Type: DefinedTerm, Agent, Person, Person, PersonalName, Aggregation, Thing

[Quick search] [I] [search icon]

source	Singapore Infopedia: Sir Stamford Raffles' career and contributions to Singapore(http://infopedia.nl.sg/articles/SIP_715_2004-12-15.html)
altLabel	Thomas Stamford Raffles, Stamford Raffles, ராஃபில்ஸ், தாமஸ் ஸ்டாம்ஃபோர்ட், 莱佛士, 托马斯斯坦福
related	Farquhar, William, Crawford, John, Raffles, Sophia, Lady, Raffles, Olivia Mariamne, Abdullah, Munshi, Johnston, Alexander Laurie



> Occupation

DefinedTerm Person PersonalName Thing

Colonial administrator

British colonial administrator best known as the founder of modern Singapore. He was Lieutenant-Governor of British Java (1811-1815) and Governor-General of Bencoolen (1817-1822). Raffles first arrived in Singapore on 29 January 1819, and by 6 February 1819 had signed a treaty and raised the Union Jack on the island. Among his other contributions was the establishment of the Singapore Institution (later known as Raffles Institution), and the Singapore Library (now known as the National Library) which was established within the Singapore Institution.

Raffles, Thomas Stamford

Person Thing

Raffles, Thomas Stamford, b. 1818

Person Thing

Edit Page	
altLabel	Thomas Stamford Raffles, Stamford Raffles, ராஃபில்ஸ், தாமஸ் ஸ்டாம்ஃபேபார்ட், 萊佛士, 托马斯斯坦福
related	Farquhar, William, Crawford, John, Raffles, Sophia, Lady, Raffles, Olivia Mariamne, Abdullah, Munshi, Johnston, Alexander Laurie
achievement	He founded Singapore in 1819, and established it as a free port. He conceived a town plan to remodel Singapore into a modern city, with separate areas for different ethnic groups and facilities such as roads, schools and land for government buildings. He established the Singapore Institution (now Raffles Institution).
alternateName	Thomas Stamford Raffles, Stamford Raffles, ராஃபில்ஸ், தாமஸ் ஸ்டாம்ஃபேபார்ட், 萊佛士, 托马斯斯坦福
birthDate	1781, 1781-07-06
birthPlace	Jamaica
deathDate	1826, 1826-07-05
description	British colonial administrator best known as the founder of modern Singapore. He was



Search Results: Thomas Raffles

[Edit Page](#)

Person 5
Organisation 0
Work 179
Place 0
Topic 115
RESET

Filters Clear All

- Type
- Alumni Of
- Affiliation
- Nationality
- Birth Date
- Occupation

+ Create Person
Export
Reset selection

- Raffles, Thomas, 1788-1863**
DefinedTerm Person PersonalName Thing
- Raffles, Thomas Stamford, Sir**
DefinedTerm Person PersonalName Thing
- Raffles, Thomas Stamford, Sir**
DefinedTerm Person PersonalName Thing
- Raffles, Thomas Stamford**
Person Thing

Colonial administrator

British colonial administrator best known as the founder of modern Singapore. He was Lieutenant-Governor of British Java (1811-1815) and Governor-General of Bencoolen (1817-1822). Raffles first arrived in Singapore on 29 January 1819, and by 6 February 1819 had signed a treaty and raised the Union Jack on the island. Among his other contributions was the establishment of the Singapore Institution (later known as Raffles Institution), and the Singapore Library (now known as the National Library) which was established within the Singapore Institution.

Raffles, Thomas Stamford, Sir ×

[Navigate to resource](#)

URI: <https://eresources.nlb.gov.sg/linkeddata/primary-...>

Type: DefinedTerm, Agent, Person, Person, PersonalName, Aggregation, Thing

Quick search

source	Singapore Infopedia: Sir Stamford Raffles' career and contributions to Singapore(http://infopedia.nl.sg/articles/SIP_715_2004-12-15.html)
altLabel	Thomas Stamford Raffles, Stamford Raffles, ராஃபில்ஸ், தாமஸ் ஸ்டாம்ஃபோர்ட், 莱佛士, 托马斯斯坦福
related	Farquhar, William, Crawford, John, Raffles, Sophia, Lady, Raffles, Olivia Mariamne, Abdullah, Munshi, Johnston, Alexander Laurie
achievement	He founded Singapore in 1819, and established it as a free port. He conceived a town plan to remodel Singapore into a



Add description

Edit Page

Alternate Name ?

TTE	Thomas Stamford Raffles	
TTE	Stamford Raffles	
TTE	ராஃபில்ஸ், தாமஸ் ஸ்டாம்ஃபோர்ட்	
TTE	莱佛士, 托马斯斯坦福	
Enter alternate name here...		

Add alternate name

Birth Date ?

ILS,CMS	1781	
TTE	1781-07-06	
Enter birth date here...		

Add birth date

Death Date ?

ILS,CMS	1826	
TTE	1826-07-05	
Enter death date here...		

Add death date

Has Occupation ?



SPARQL

Assets



Add description

Edit Page

Confirm suppression of record?

Cancel

Confirm

Alternate Name ?

TTE	Thomas Stamford Raffles	
TTE	Stamford Raffles	
TTE	ராஃபில்ஸ், தாமஸ் ஸ்டாம்ஃபோர்ட்	
TTE	莱佛士, 托马斯斯坦福	
Enter alternate name here...		

Add alternate name

Birth Date ?

ILS,CMS	1781	
TTE	1781-07-06	
Enter birth date here...		

Add birth date

Death Date ?

ILS,CMS	1826	
TTE	1826-07-05	
Enter death date here...		

Add death date

Has Occupation ?



Add description

Edit Page

Alternate Name ?

TTE	Thomas Stamford Raffles	
TTE	Stamford Raffles	
TTE	ராஃபில்ஸ், தாமஸ் ஸ்டாம்ஃபோர்ட்	
TTE	莱佛士, 托马斯斯坦福	
Enter alternate name here...		

Add alternate name

Birth Date ?

ILS,CMS	1781	
TTE	1781-07-06	
Enter birth date here...		

Add birth date

Death Date ?

ILS,CMS	1826	
TTE	1826-07-05	
Enter death date here...		

Add death date

Has Occupation ?



Add description

Edit Page

Alternate Name ?

TTE	Thomas Stamford Raffles	
TTE	Stamford Raffles	
TTE	ராஃபில்ஸ், தாமஸ் ஸ்டாம்கிபோர்ட்	
TTE	莱佛士, 托马斯斯坦福	
Enter alternate name here...		

Add alternate name

Birth Date ?

ILS,CMS	1781	
TTE	1781-07-06	
Enter birth date here...		

Add birth date

Death Date ?

ILS,CMS	1826	
TTE	1826-07-05	
Enter death date here...		

Add death date

Has Occupation ?



Edit Page

Add death date

Has Occupation ?

TTE Colonial administrator 

Enter has occupation here... 

Add has occupation

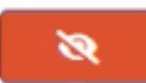
Nationality ?


TTE British 

Enter nationality here... 

Add nationality


Birth Place ?


TTE Jamaica 

Enter birth place here... 

Add birth place

Honorific Prefix ?

TTE Sir 

Enter honorific prefix here... 

Add honorific prefix

Alumni Of ?



Add death date

Edit Page

Has Occupation ?

TTE Colonial administrator

Enter has occupation here...

Add has occupation

Nationality ?

TTE British

Enter nationality here...

Add nationality

Birth Place ?

TTE Jamaica

Onboard the ship "Ann" off of the coast of Jamaica

Add birth place

Honorific Prefix ?

TTE Sir

Enter honorific prefix here...

Add honorific prefix

Alumni Of ?

Enter alumni of here...



Add related

Edit Page

Same As ?

ILS, LINKING	http://id.loc.gov/authorities/names/n81097180	
ILS, TTE	http://viaf.org/viaf/66670173	
ILS	http://id.worldcat.org/fast/fst00078208	
ILS	http://viaf.org/viaf/310921507	
ILS	http://id.worldcat.org/fast/00078208	
TTE, LINKING	http://www.wikidata.org/entity/Q130327	
TTE, LINKING	http://dbpedia.org/resource/Stamford_Raffles	
FAST	http://id.worldcat.org/fast/78208	
LINKING	http://vocab.getty.edu/ulan/500237686-agent	
LINKING	http://d-nb.info/gnd/119049538	
LINKING	http://isni.org/isni/0000000121375424	
LINKING	http://www.idref.fr/073922021/id	
LINKING	http://id.ndl.go.jp/auth/entity/00621334	
LINKING	http://data.bibsys.no/data/notrbib/authorityentry/x90695518	
LINKING	http://viaf.org/viaf/sourceID/LC%7Cn++81097180#skos:Concept	

Enter sameas here...



Add sameas

Save

Reset



Raffles, Thomas Stamford, Sir

MODIFIED



Export

Create entity

Edit Page



URI: <https://eresources.nlb.gov.sg/linkeddata/primary-entity/person/3386c677-610b-4dc1-971a-b44361024a25>

NLB-TTE: 18338326

General

Additional information

Incoming relations

Aggregations

Notes

Publishing lineage

Preview changes

General information

Type

ILS,TTE	DefinedTerm	
ILS,TTE	Agent	
ILS,CMS,TTE	Person	
ILS,TTE	Person	
ILS	PersonalName	

Name

ILS,TTE	Raffles, Thomas Stamford, Sir	
ILS,CMS,TTE	Raffles, Thomas Stamford, Sir, 1781-1826	
ILS	Raffles, Thomas Stamford, Sir, 1781-1826 Sir, 1781-1826	
ILS,TTE	Raffles, Thomas Stamford	
ILS	Raffles, Thomas Stamford, Sir, 1781-1826 Sir	
ILS	Sir Thomas Stamford Raffles	



Raffles, Thomas Stamford, Sir

MODIFIED



Export ▾

Create entity ▾

Edit Page

URI: <https://eresources.nlb.gov.sg/linkeddata/primary-entity/person/3386c677-610b-4dc1-971a-b44361024a25>

NLB-TTE: 18338326

General

Additional information

Incoming relations

Aggregations

Notes

Publishing lineage

Preview changes



Preview

Name

- Raffles, Thomas Stamford, Sir (ILS, TTE)
- Raffles, Thomas Stamford, Sir, 1781-1826 (ILS, CMS, TTE)
- Raffles, Thomas Stamford, Sir, 1781-1826 Sir, 1781-1826 (ILS)
- Raffles, Thomas Stamford (ILS, TTE)
- Raffles, Thomas Stamford, Sir, 1781-1826 Sir (ILS)
- Sir Thomas Stamford Raffles (TTE)

Alternative name

- Thomas Stamford Raffles (TTE)
- Stamford Raffles (TTE)
- ராஃபில்ஸ், தாமஸ் ஸ்டாம்ஃபர்ட் (TTE)
- 莱佛士, 托马斯斯坦福 (TTE)

Description

- British colonial administrator best known as the founder of modern Singapore. He was Lieutenant-Governor of British Java (1811-1815) and Governor-General of Bencoolen (1817-1822). Raffles first arrived in Singapore on 29 January 1819, and by 6 February 1819 had signed a treaty and raised the Union Jack on the island. Among his other contributions was the establishment of the Singapore Institution (later known as Raffles Institution), and the Singapore Library (now known as the National Library) which was established within the Singapore Institution. (TTE)

Birth date

- 1781 (ILS, CMS)
- 1781-07-06 (TTE)

Death date

- 1826 (ILS, CMS)
- 1826-07-05 (TTE)

Nationality

- British (TTE)

Has Occupation

- Colonial administrator (TTE)

Award

(empty)

Spouse

- Raffles, Olivia Mariamn (m. 1805) (TTE)
- Raffles, Sophia, Lady (m. 1817) (TTE)



- Lyde, Ann (TTE)

[Edit Page](#)

Honorific Prefix

- Sir (TTE)

Subject Of

- 44f05fdc-55c6-4fba-8beb-f29d5cabffe2 (TTE)
- d28f3a56-1161-11e3-83d5-0050568939ad (TTE)
- 34862c27-1162-11e3-83d5-0050568939ad (TTE)
- e3fb05c6-1161-11e3-83d5-0050568939ad (TTE)

Same As

- <http://id.loc.gov/authorities/names/n81097180> (ILS, LINKING)
- <http://viaf.org/viaf/66670173> (ILS, TTE)
- <http://id.worldcat.org/fast/fst00078208> (ILS)
- <http://viaf.org/viaf/310921507> (ILS)
- <http://id.worldcat.org/fast/00078208> (ILS)
- <http://www.wikidata.org/entity/Q130327> (TTE, LINKING)
- http://dbpedia.org/resource/Stamford_Raffles (TTE, LINKING)
- <http://id.worldcat.org/fast/78208> (FAST)
- <http://vocab.getty.edu/ulan/500237686-agent> (LINKING)
- <http://d-nb.info/gnd/119049538> (LINKING)
- <http://isni.org/isni/0000000121375424> (LINKING)
- <http://www.idref.fr/073922021/id> (LINKING)
- <http://id.ndl.go.jp/auth/entity/00621334> (LINKING)
- <http://data.bibsys.no/data/notrbib/authorityentry/x90695518> (LINKING)
- <http://viaf.org/viaf/sourceID/LC%7Cn++81097180#skos:Concept> (LINKING)

Related

- Crawford, John (TTE)
- Farquhar, William (TTE)
- Abdullah, Munshi (TTE)
- Raffles, Olivia Mariamne (TTE)
- Raffles, Sophia, Lady (TTE)
- Johnston, Alexander Laurie (TTE)

Birth Place

- [Jamaica \(TTE\)](#)
- [Onboard the ship "Ann" off of the coast of Jamaica \(+\)](#)

► Additional information

Publish



Honorific Prefix

- Sir (TTE)

Publish

Comment

Two less accurate birth and death dates are suppressed and more accurate place of birth is manually added



Publish

Cancel

- [mes/n81097180](#) (ILS, LINKING)
- [LS, TTE\)](#)
- [0078208](#) (ILS)
- [\(ILS\)](#)
- [78208](#) (ILS)
- [/Q130327](#) (TTE, LINKING)
- [lamford_Raffles](#) (TTE, LINKING)

- <http://id.worldcat.org/fast/78208> (FAST)
- <http://vocab.getty.edu/ulan/500237686-agent> (LINKING)
- <http://d-nb.info/gnd/119049538> (LINKING)
- <http://isni.org/isni/0000000121375424> (LINKING)
- <http://www.idref.fr/073922021/id> (LINKING)
- <http://id.ndl.go.jp/auth/entity/00621334> (LINKING)
- <http://data.bibsys.no/data/notrbib/authorityentry/x90695518> (LINKING)
- <http://viaf.org/viaf/sourceID/LC%7Cn++81097180#skos:Concept> (LINKING)

Related

- [Crawfurd, John](#) (TTE)
- [Farquhar, William](#) (TTE)
- [Abdullah, Munshi](#) (TTE)
- [Raffles, Olivia Mariamne](#) (TTE)
- [Raffles, Sophia, Lady](#) (TTE)
- [Johnston, Alexander Laurie](#) (TTE)

Birth Place

- [Jamaica](#) (TTE)
- [Onboard the ship "Ann" off of the coast of Jamaica](#) (+)

▶ Additional information

Publish



Raffles, Thomas Stamford, Sir

PUBLISHED



Export ▾

Create entity ▾

Edit Page

URI: <https://eresources.nlb.gov.sg/linkeddata/primary-entity/person/3386c677-610b-4dc1-971a-b44361024a25>

NLB-TTE: 18338326

General

Additional information

Incoming relations

Aggregations

Notes

Publishing lineage

Preview changes

Preview

Name

- Raffles, Thomas Stamford, Sir (ILS, TTE)
- Raffles, Thomas Stamford, Sir, 1781-1826 (ILS, CMS, TTE)
- Raffles, Thomas Stamford, Sir, 1781-1826 Sir, 1781-1826 (ILS)
- Raffles, Thomas Stamford (ILS, TTE)
- Raffles, Thomas Stamford, Sir, 1781-1826 Sir (ILS)
- Sir Thomas Stamford Raffles (TTE)

Alternative name

- Thomas Stamford Raffles (TTE)
- Stamford Raffles (TTE)
- ராஃபில்ஸ், தாமஸ் ஸ்டாம்க்ஃபர்ட் (TTE)
- 莱佛士, 托马斯斯坦福 (TTE)

Description

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Birth date

- 1781-07-06 (TTE)

Death date

- 1826-07-05 (TTE)

Has Occupation

- Colonial administrator (TTE)

Award

(empty)

Nationality

- British (TTE)

Spouse

- Raffles, Olivia Mariamn (m. 1805) (TTE)
- Raffles, Sophia, Lady (m. 1817) (TTE)

NLB KNOWLEDGE DISCOVERY

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Raffles, Thomas Stamford, Sir

Person

Colonial administrator

British colonial administrator best known as the founder of modern Singapore. He was Lieutenant-Governor of British Java (1811-1815) and Governor-General of Bencoolen (1817-1822). Raffles first arrived in Singapore on 29 January 1819, and by 6 February 1819 had signed a treaty and raised the Union Jack on the island. Among his other contributions was the establishment of the Singapore Institution (later known as Raffles Institution), and the Singapore Library (now known as the National Library) which was established within the Singapore Institution.

Also known as: Thomas Stamford Raffles
Stamford Raffles
ராஃபில்ஸ், தாமஸ் ஸ்டாம்சுபோர்ட்
莱佛士, 托马斯斯坦福

Birth place: Onboard the ship "Ann" off of the coast of Jamaica

Birth date: 1781-07-06

View Full Detail



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Death date: 1826-07-05

Spouse: Raffles, Olivia Mariamn (m. 1805)
Raffles, Sophia, Lady (m. 1817)

Parent: Raffles, Benjamin
Lyde, Ann

Related: Farquhar, William
Crawfurd, John
Raffles, Sophia, Lady
Raffles, Olivia Mariamne
Abdullah, Munshi
Johnston, Alexander Laurie



External Links 4 results

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[VIAF - Virtual International Authority File](#)

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Quick search

A history of Java

Raffles, Thomas Stamford, Sir

Work

Book English



Administration of Eastern Islands

NLB KNOWLEDGE DISCOVERY

Search for books, audios, videos, and more...

A history of Java

Work Book English

Author: Raffles, Thomas Stamford, Sir

Language: English

About: Malayan languages
a41b0bbf-40b8-49d7-93ae-fb8329189c0a
57aff1ec-3c49-4b78-983d-bf73a8a00496
Indonesia--Java.
3e98b3f2-b757-4132-bb39-7b8bfc03a2a8
Java (Indonesia)--Description and travel.



Version 1 result



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Search for books, audios, videos, and more...

A history of Java

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a41b0bbf-40b8-49d7-93ae-fb8329189c0a
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Version 1 result

Quick search

A history of Java

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Work Book English

ill., maps, music Reprint. Originally published: London : Printed for Black, Parbury, and Allen, 1817.

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Indonesia--Java.

Subject

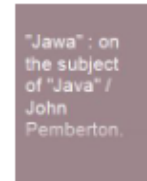
Works About Indonesia--Java. 1137 results

Quick search

"Jawa" : on the subject of "Java"

Pemberton, John

Work Book Indonesian



'T koninkryk Sunda met dat van Java by d'Inwoonderen voor een Eiland Gehouden, en door den Hr. I.B. Lavanha Als twee Eylanden Beschreven

Aa, Pieter van der

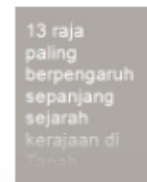
Work Map Dutch

This map of Sunda and Java appears in Pieter van der Aa's Cartes des itineraires et voyage moderne. Whilst incorrect in its view of the island, the map features a cartouche with Javanese natives encountering the Portuguese explorer Lopo vaz de Sampoya. The map is based on the work of Portuguese cartographer Joao de Barros, whose map of Java appeared in Quatra decada d'Asia in 1615. Barros own sources for this map are unknown, but it follows the Portuguese belief that Java comprised two islands, the smaller one to the west being known as Sunda. -- Dealer's description.

13 raja paling berpengaruh sepanjang sejarah kerajaan di Tanah Jawa

Achmad, Sri Wintala

Work Book Indonesian



Collective biography of kings and rulers of Java.

NLB KNOWLEDGE DISCOVERY

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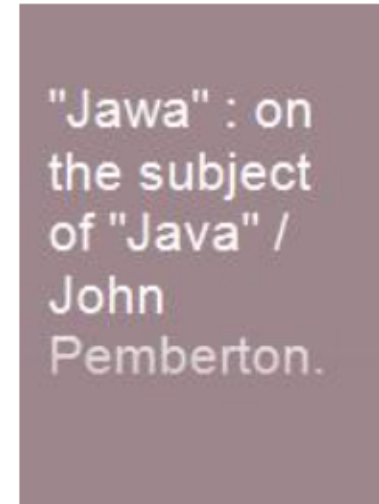
"Jawa" : on the subject of "Java"

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Version 1 result

Quick search

"Jawa" : on the subject of "Java"

Pemberton, John

Work Book Indonesian

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LDMS System Live – December 2022

- Live – data curation team using DMI
 - Entity curation
 - Manually merging & splitting aggregations



LDMS System Live – December 2022

- Live – data curation team using DMI
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 - Daily / Weekly / Monthly
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- Live – Discovery Interface ready for deployment



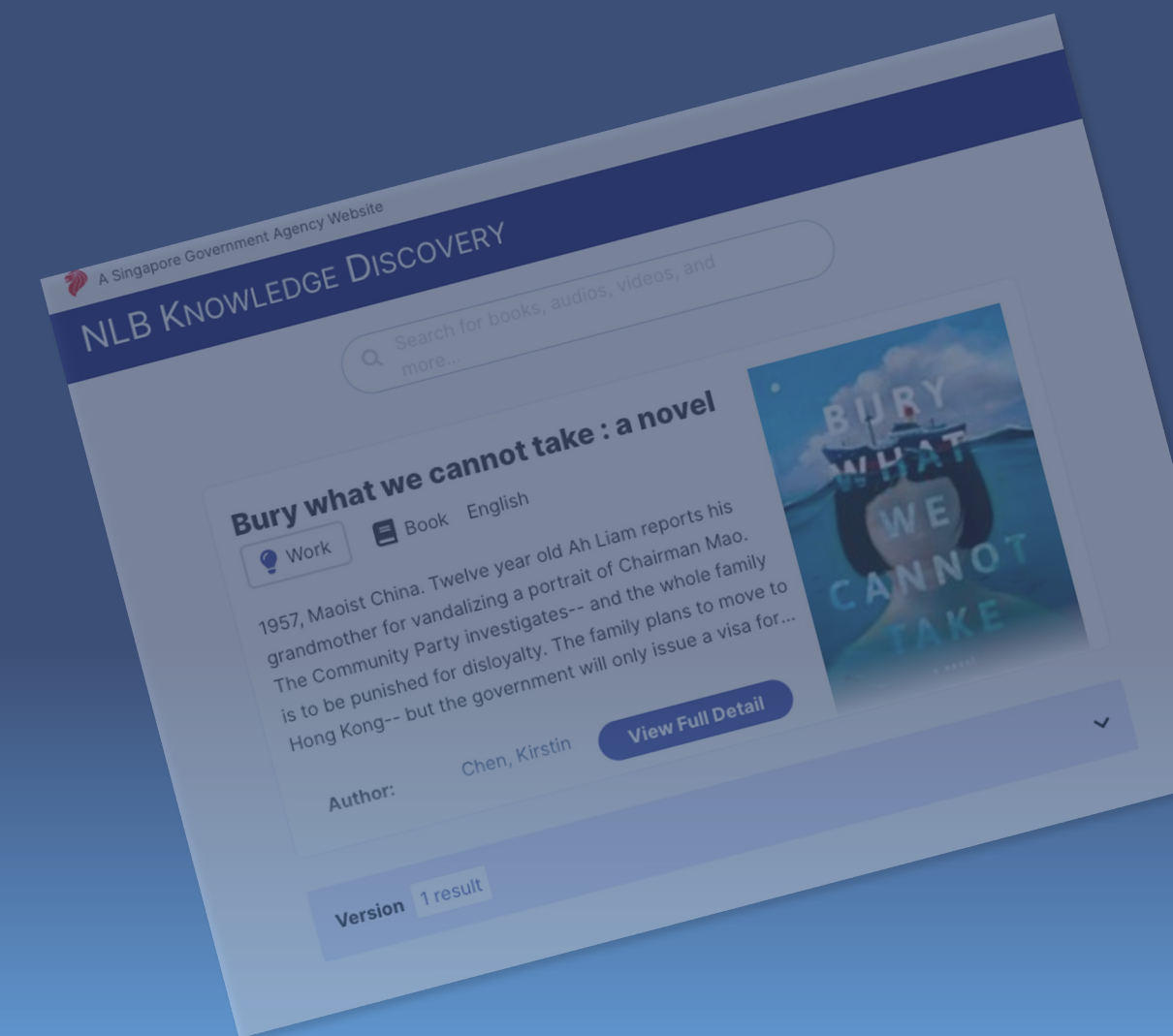
LDMS System Live – December 2022

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 - Daily / Weekly / Monthly
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- Live – Discovery Interface ready for deployment
- Live – Support
 - Issue resolution & updates



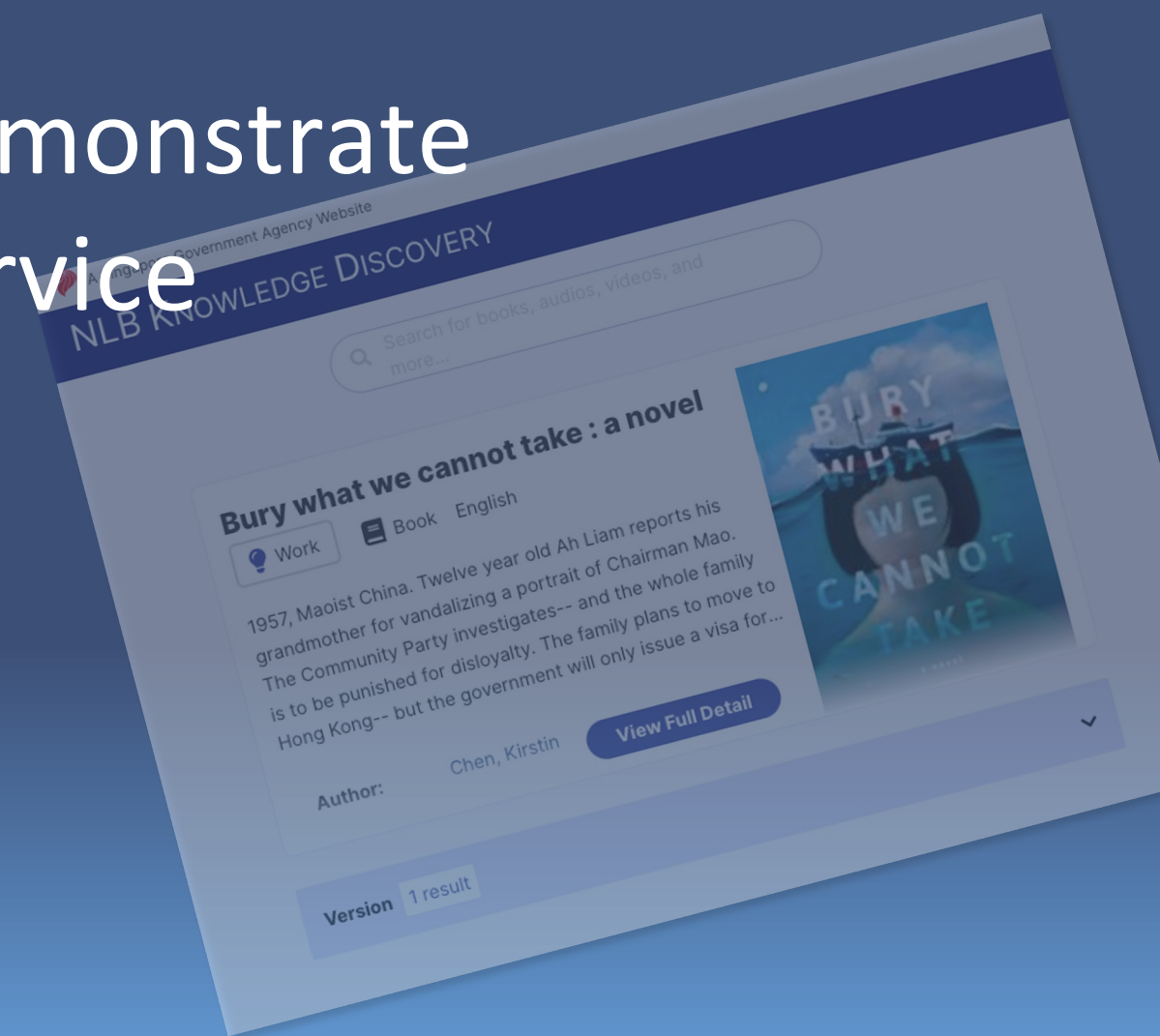
Discovery Interface

- Live and ready for deployment
 - Performance, load and user tested



Discovery Interface

- Live and ready for deployment
 - Performance, load and user tested
- Designed & developed by NLB Data Team to demonstrate characteristics and benefits of a Linked Data service

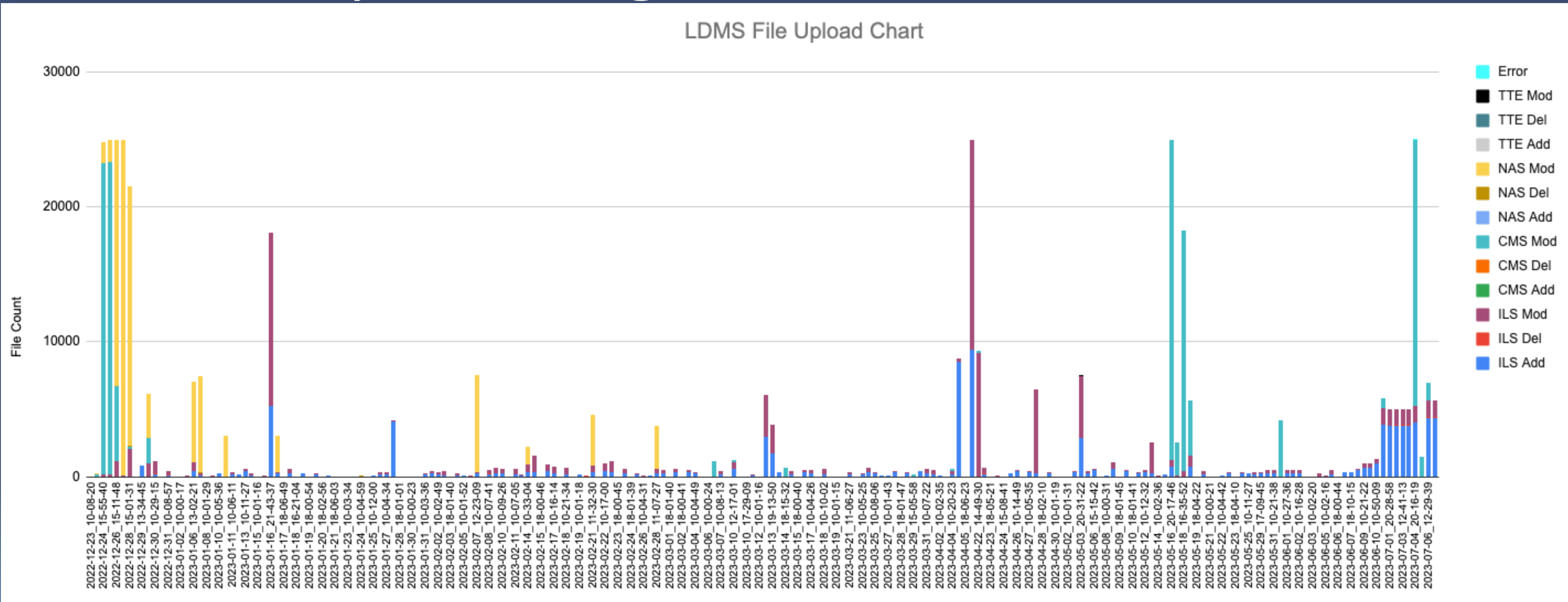


Discovery Interface

- Live and ready for deployment
 - Performance, load and user tested
- Designed & developed by NLB Data Team to demonstrate characteristics and benefits of a Linked Data service
- NLB services rolled-out by National Library & Public Library divisions
 - Recently identified a service for Linked Data integration
 - Currently undergoing fine tuning to meet service's UI requirements



Daily Delta Ingestion & Reconciliation



Some Challenges Addressed on the Way

Hash URIs

Some Challenges Addressed on the Way

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- Output from marc2bibframe2 – entity URIs:

`https://eresources.nlb.gov.sg/linkeddata/ils/83411#Work`

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- Change in import pipeline:

`https://eresources.nlb.gov.sg/linkeddata/ils/83411/Work`

Some Challenges Addressed on the Way

The 'id.loc.gov' problem

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```
<marc:datafield tag="338" ind1="." ind2=".">
  <marc:subfield code="a"><![CDATA[volume]]></marc:subfield>
  <marc:subfield code="b"><![CDATA[nc]]></marc:subfield>
  <marc:subfield code="2"><![CDATA[rdacarrier]]></marc:subfield>
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<bf:Carrier rdf:about="http://id.loc.gov/vocabulary/carriers/nc">
  <rdfs:label>volume</rdfs:label>
  <bf:source>
    <bf:Source rdf:about="http://id.loc.gov/vocabulary/genreFormSchemes/rdacarrier"/>
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⇒

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- Resulting triple loaded into graph:

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- Resulting triple loaded into graph:

```
<http://id.loc.gov/vocabulary/carriers/nc> rdfs:label "volume".
```


- But what if there is an error in the data?

```
<http://id.loc.gov/vocabulary/carriers/nc> rdfs:label "computer disc".
```

Some Challenges Addressed The 'id.loc.gov

```
1 PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
2 SELECT *
3 WHERE {
4   <http://id.loc.gov/vocabulary/carriers/nc> rdfs:label ?label.
5 }limit 100
```

Repository: (from context)

Table 

Quick search

label
computer disc (xsd:string)
audio disc (xsd:string)
videodisc (xsd:string)
volume (xsd:string)
unmediated (xsd:string)
sheet (xsd:string)
volumes (xsd:string)
band (xsd:string)


Some Challenges Addressed

The 'id.loc.gov

- Tracking down the offending record can be a challenge!

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1 PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
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- Single error can pollute a primary entity
 - Especially common ones
- Term suppression in DMI
powerful tool to handle these

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3 WHERE {
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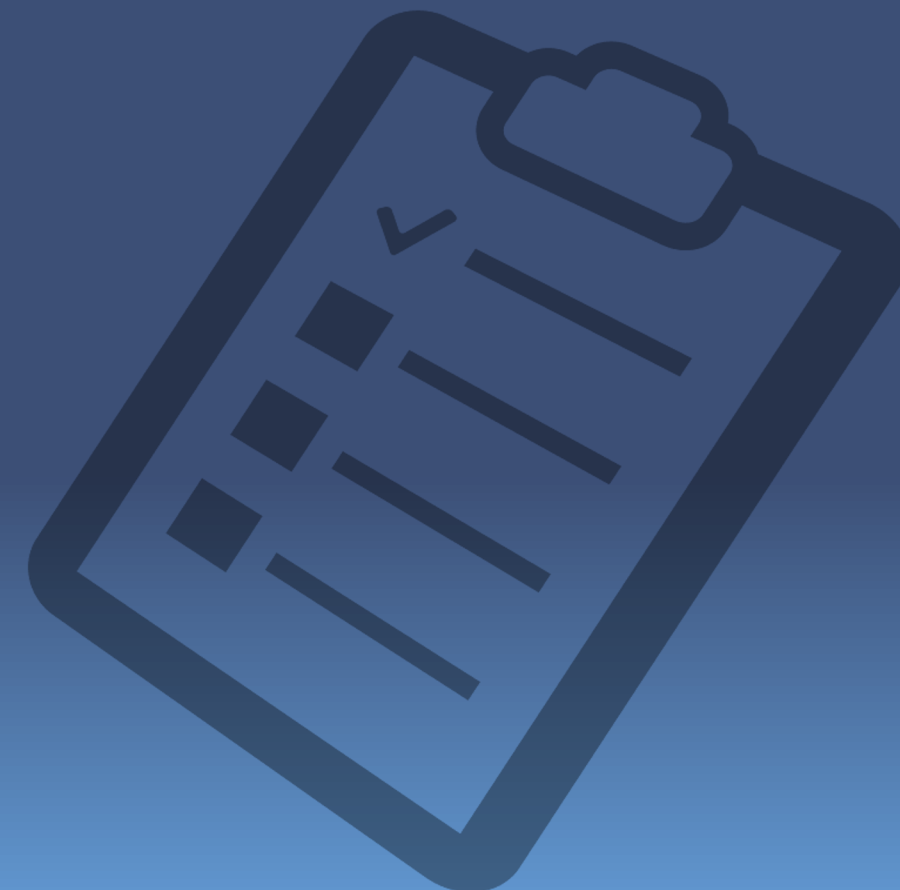
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From Ambition to Go Live – A Summary

- Ambition based on previous years of trials, experimentation, and understanding of Linked Data potential



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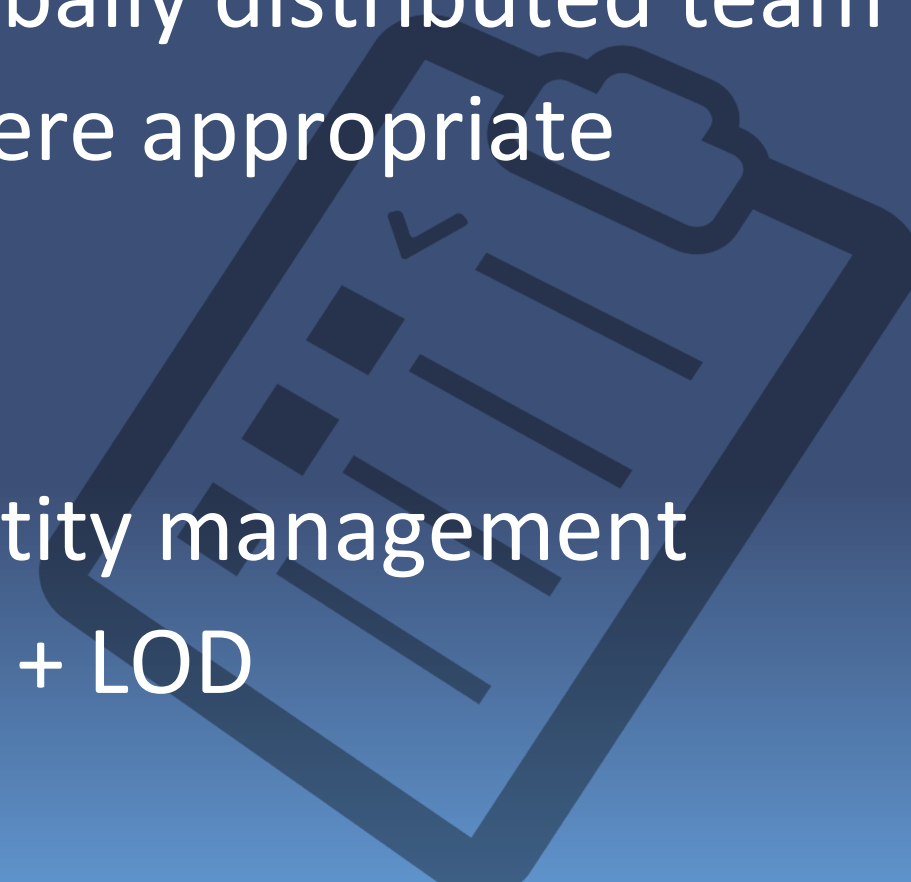
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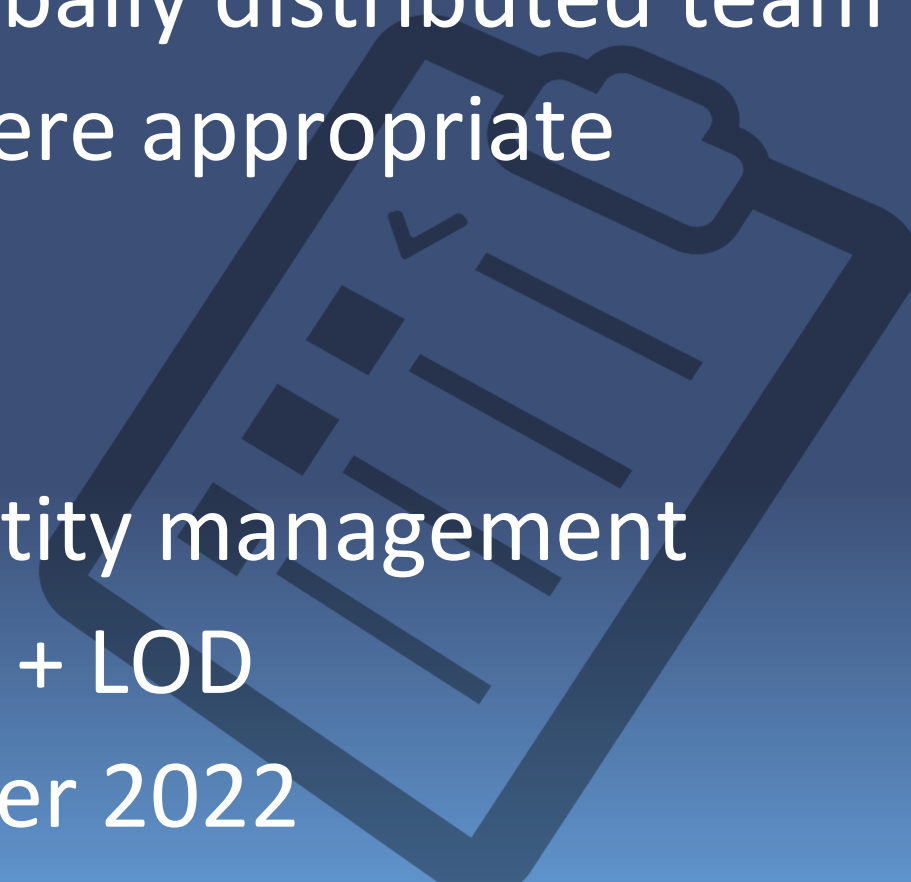
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 - Auto updating, consolidated entity view – plus individual entity management
 - Web friendly – providing structured data for search engines + LOD



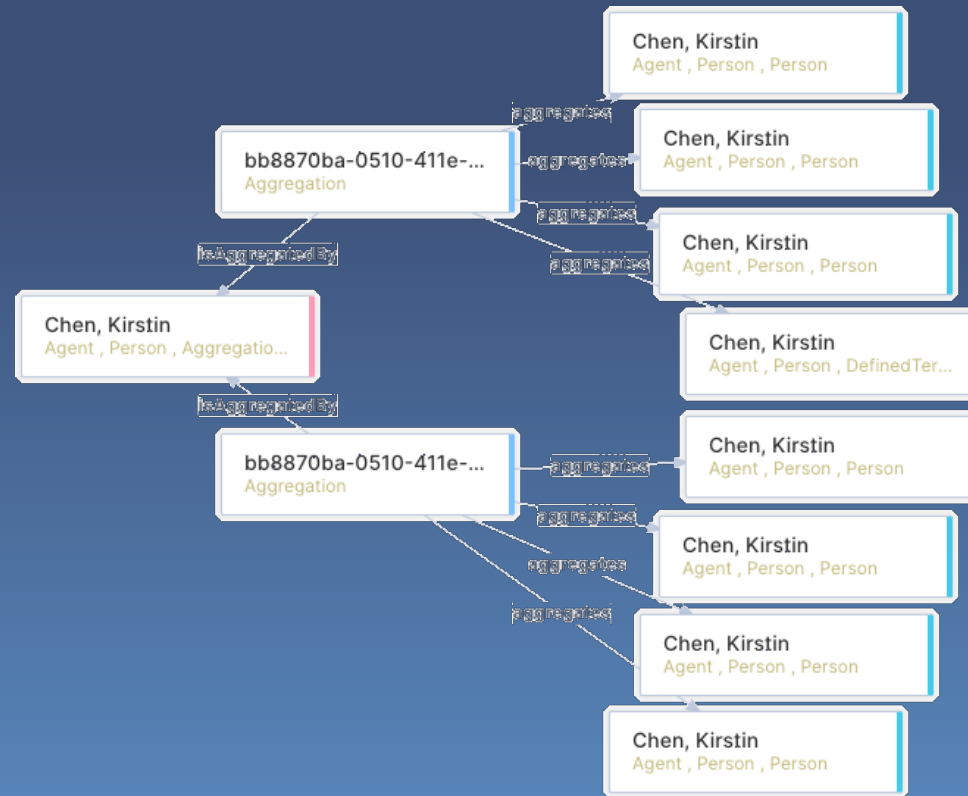
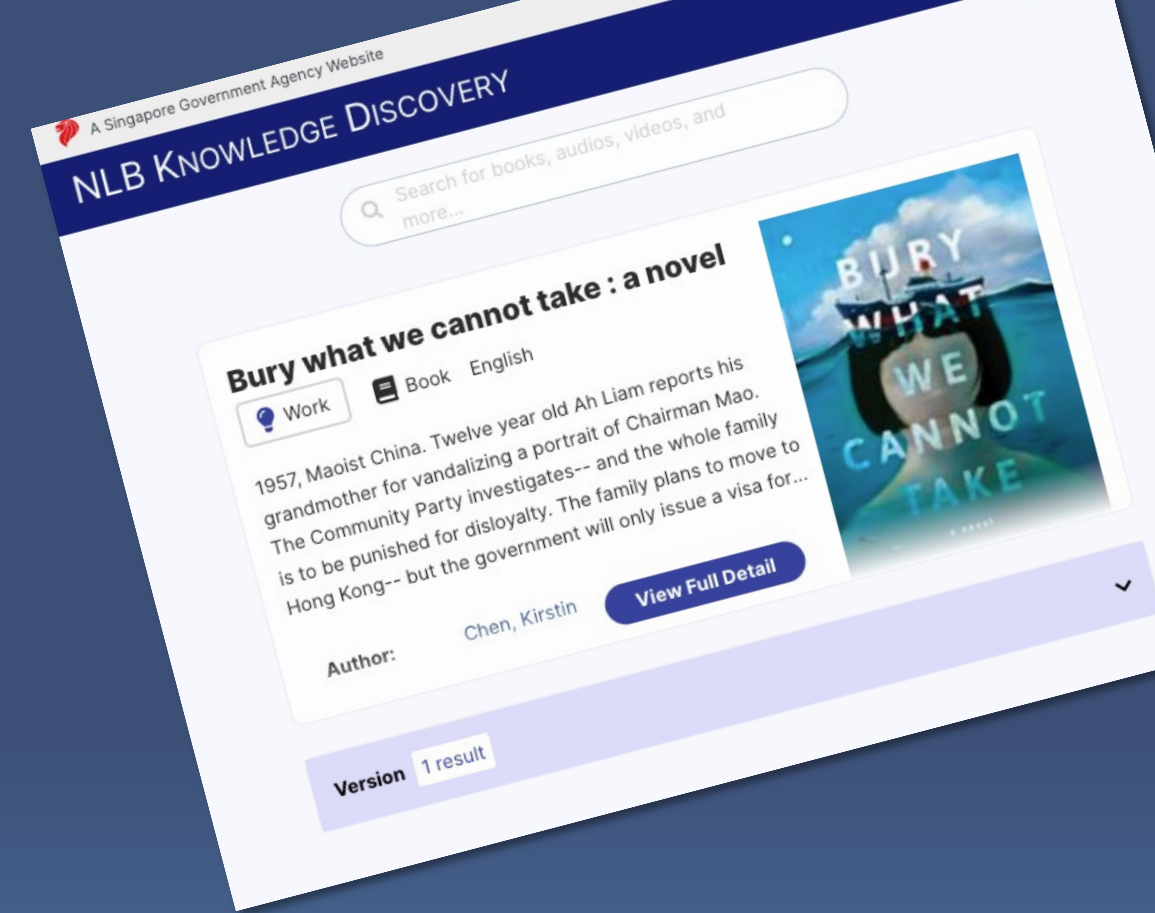
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 - Web friendly – providing structured data for search engines + LOD
- Live and operational actively delivering benefits from December 2022



From Ambition to Go Live

The National Library Board of Singapore's Journey to an operational Linked Data Management and Discovery System



Richard Wallis
Evangelist and Founder
Data Liberate
richard.wallis@dataliberate.com
@dataliberate



BIBFRAME Workshop in Europe 2023
19th September 2023 - Brussels

