

Authoritative content to build trust in an age of information overload: The National Library Board of Singapore's experience

Puay Eng TANG

Resource Discovery, National Library Board, Singapore.
TANG_Puay_Eng@nlb.gov.sg

Glenn HONG

Resource Discovery, National Library Board, Singapore.
Glenn_HONG@nlb.gov.sg

Haliza JAILANI

Resource Discovery, National Library Board, Singapore.
Haliza_JAILANI@nlb.gov.sg



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Abstract:

The National Library Board of Singapore (NLB) has created thousands of authorised local names over the past 10 years for indexing of its resources. These names of entities comprise people, organisations and places and include their variant forms such as aliases and previous or successive forms. The names also contain further information about the entity, such as the achievements of a person, latitude and longitude of a place or the founding year of an organisation. NLB ensures trustworthiness of the data through authoritative research and by cross-checking content gleaned from crowdsourced knowledge bases such as Wikipedia. Data authenticity and transparency are maintained through policy guidelines governing acceptable sources of data and provenance of the data sourced. These include data from Singapore's cultural institutions (Galleries, Libraries, Archives & Museums) which are aggregated to enable seamless searching on NLB's single-search platform, OneSearch.

These names are published in Singapore's four official languages on international registries such as the Virtual International Authority File (VIAF). We also intend to open up these names to other Singapore government agencies through the NLB Name Authorities platform. In making the name authority records available locally and overseas, indexing of content resources can be improved through the consistency of names used and the context provided with the information in each name record. As a knowledge base of local entities, the information is used as a data dictionary in NLB's named-entity recognition that supports automatic indexing and is displayed in a knowledge panel on OneSearch when people search for these entities.

In this paper, we will share our experience in building NLB's knowledge organisation system's (KOS) knowledge base of Singaporean and Southeast Asian names to meet the paradoxical challenge of facilitating timely, relevant and trustworthy information in an increasingly amorphous digital world.

Keywords: controlled vocabularies, knowledge organisation system, trusted content, data authenticity, fact checking.

1. INTRODUCTION

We live in a paradoxical digital age where the greater the access to information that we have, the harder it is for us to distinguish fact from fiction and untruths. Many experts identified the breakdown of trusted information sources as one of the “grand challenges we face in the 21st century” as reported in a BBC Future Now interview in early 2017.¹ Misinformation and fake news have become such overwhelming concerns that “post-truth” is unsurprisingly chosen as the Oxford Dictionaries’ Word of the Year in 2016.²

To counteract this proliferation of selective promotion and filtering of information online, libraries can support the United Nations 2030 agenda of providing access and opportunity for all by not just providing equitable access to information, but by validating information and promoting reliable, verified content.³

To this end, the National Library Board of Singapore (NLB) has established a rigorous process to ensure data authenticity and trustworthiness for its range of controlled vocabularies, taxonomies and authorised name headings as its Knowledge Organisation System (KOS).

2. SCOPE AND OBJECTIVES OF NLB’s KOS

While Library of Congress Name Authorities (LCNA, see <https://authorities.loc.gov>) are used as the de facto standard for libraries in the English-speaking world, there exist gaps where Singapore and Southeast Asian entities are more commonly known by another name in the local context (e.g. use of dialect name instead of the hanyu pinyin name for ethnic Chinese persons) and some entities are not prominent enough or possess sufficient literary warrant to be established in international vocabularies like LCNA. Based on the ANSI/NISO Z39.19 guidelines, NLB’s KOS fills this gap through its development and maintenance of user-centric, Singapore-centric and Southeast Asian-centric name authorities.

Originally created as a project between September 2007 to 2010, KOS is a set of multilingual controlled vocabularies originally developed to describe NLB’s digital content. It comprised of a conceptual base, a subject taxonomy and 18 descriptive vocabularies with facets in

¹ BBC Future Now. “Lies, propaganda and fake news: A challenge for our age”. Last accessed on May 4, 2018. <http://www.bbc.com/future/story/20170301-lies-propaganda-and-fake-news-a-grand-challenge-of-our-age>

² Oxford Dictionaries. “Word of the Year 2016”. Last accessed on May 4, 2018. <https://en.oxforddictionaries.com/word-of-the-year/word-of-the-year-2016>

³International Federation of Library Associations and Institutions (2018). “Access and Opportunity for All: How Libraries Contribute to the United Nations 2030 Agenda”. Last accessed on May 4, 2018. <https://www.ifla.org/files/assets/hq/topics/libraries-development/documents/access-and-opportunity-for-all.pdf>

Singapore’s four official languages – English, Chinese, Malay and Tamil. It holds intra-vocabulary and inter-vocabulary relationship mappings of entities, such as people, organisations and places (see Figure 1).

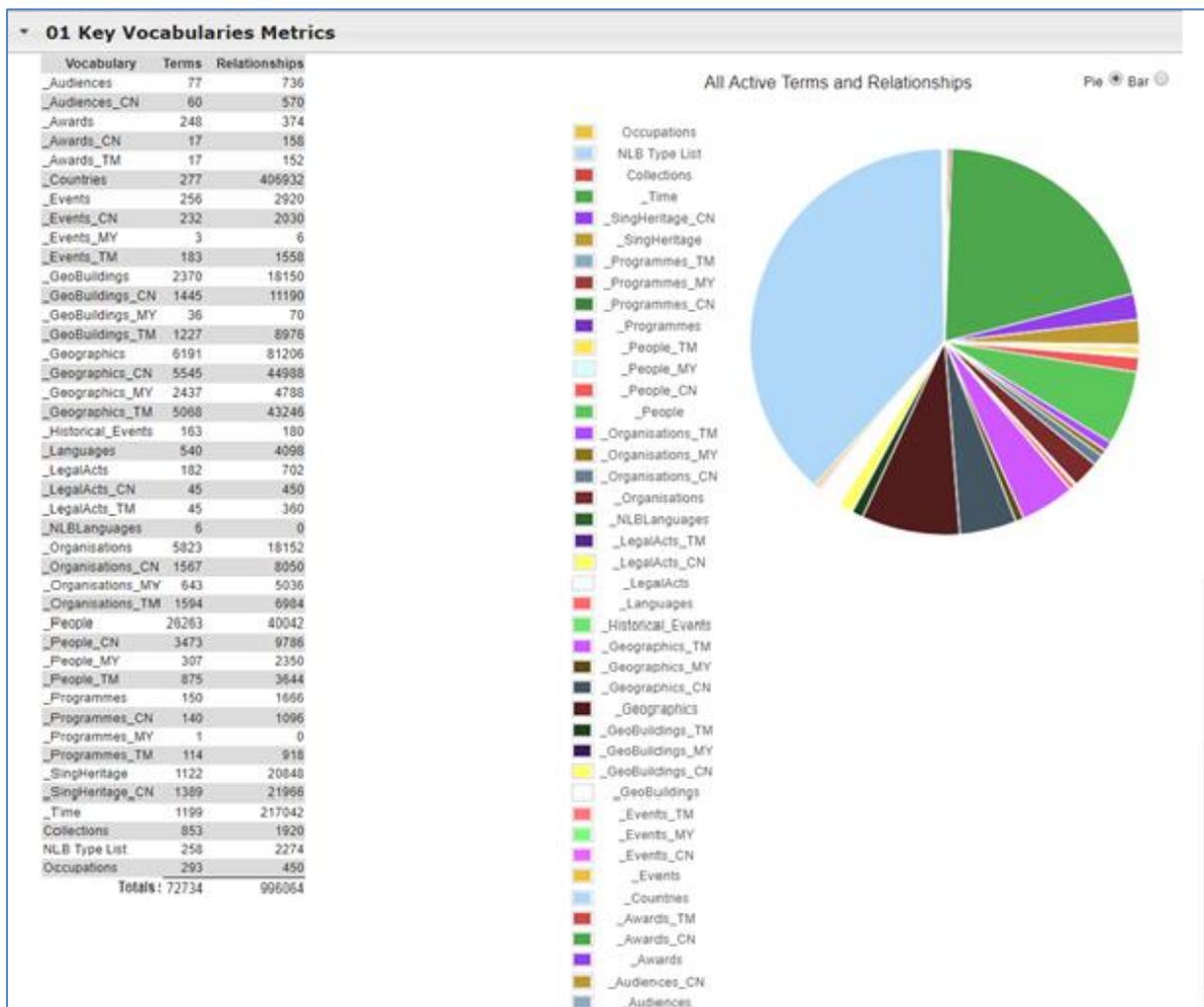


Figure 1: KOS vocabularies in its knowledge base

KOS aims to uphold consistency and accuracy in description and indexing to facilitate user discovery of library resources and improving access to NLB’s online collections. It also forms the base of NLB’s earliest efforts in creating Linked Data to improve discoverability of its resources. The outcomes delivered serve to meet the following NLB’s strategic objectives:

- Excellence in Singapore and Regional Content
- Digital Library Anytime, Anywhere
- Next Generation Libraries

Over time, KOS has expanded its role from describing NLB’s resources to include those of partner collections, which are made accessible through NLB’s aggregated search platform, OneSearch (search.nlb.gov.sg). NLB’s partners include cultural heritage institutions such as the National Archives of Singapore (NAS), the National Heritage Board (NHB) and the National Gallery of Singapore (NGS). This richness of content from Singapore’s cultural heritage sector allows NLB to provide a wide range of resources and a more informative user experience on the Internet.

Singapore’s well-known multi-disciplinary artist Tan Swie Hian is one example of a local name created. Established as “Chen, Ruixian, 1943-” in LCNA, he is known in Singapore by his popular local name “Tan, Swie Hian” (see Figure 2).

Authorised Name	Tan, Swie Hian
Authorised Name Details	<p>Name: Tan, Swie Hian Name (LCNA): Chen, Ruixian, 1943-</p> <p>Description: Multi-disciplinary Singaporean artist known for his poetry, novels, paintings, calligraphy and sculptures. He has won several awards in Singapore and overseas in the fields of literature, visual arts and the performing arts. He worked as a press secretary at the French embassy for 24 years after graduating from university in 1968. He retired early in 1992 to pursue the arts. He was conferred the Cultural Medallion for Visual Arts in 1987. The Tan Swie Hian Museum, established in 1993, is the first in Singapore that is dedicated to a living artist. It houses Tan's work from the 1960s to 2010s.</p> <p>Source: Singapore Infopedia: Tan Swie Hian (http://resources.nlb.gov.sg/infopedia/articles/SIP_2014-03-03_130547.html) 5 things to know about Singapore artist Tan Swie Hian (http://www.straitstimes.com/lifestyle/visual-arts/story/5-things-know-about-singapore-artist-tan-swie-hian-20141201#sthash.fJ2q2U7h.dpuf) Museum Roundtable: Tan Swie Hian Museum (http://www.museums.com.sg/about-us/mr-directory/art/tan-swie-hian-museum)</p> <p>Birth Year (yyyy): 1943 Birth Month (mm): 05 Birth Day (dd): 05 Parent: Tan Chan Pok Nationality: Singaporean Place of Birth: Pulau Halang, Indonesia Occupation: Artist Writer Achievements: A highly esteemed artist who received multiple accolades both locally and internationally in literature, visual arts and the performing arts. His first Chinese poetry collection, The Giant (1968), a collection of modernist, avant-garde Chinese poetry was a landmark work that rocked the literary scene in Malaysia and Singapore, establishing him as a poet of standing. He was one of 98 artists selected by the United Nations to illustrate a new edition of the Universal Declaration of Human Rights in 1998. Time magazine described him as "Singapore's Renaissance Man." Education: Chinese High School Nanyang University Awards: Chevalier de l'Ordre des Arts et des Lettres (1978) National Book Development Council of Singapore Book Award (1978) Cultural Medallion (1987) Chevalier de l'Ordre Nationale du Merite (1989) Singapore Chinese Literature Prize (1998) Meritorious Service Medal (2003) Officer of the Ordre National de la Légion d'Honneur (2006) Distinguished Patron of Heritage Award (2007) Affiliations(groupName): Tan Swie Hian Museum VIAF URI: http://viaf.org/viaf/29541038 DBpedia URI: http://dbpedia.org/resource/Tan_Swie_Hian Image Link: http://www.nas.gov.sg/archivesonline/photographs/record-details/b7b272b-1162-11e3-83d5-0050568939ad http://www.nas.gov.sg/archivesonline/photographs/record-details/98247864-1162-11e3-83d5-0050568939ad</p>
Related Names	<p>Also known as Chen, Ruixian, 1943- Also known as Tan Swie Hian ENGtoCHI 陈瑞献</p>

Figure 2: Singapore artist Chen Ruixian is established by his commonly known dialect name Tan Swie Hian

As a KOS name, this form of his name is used to index and aggregate various records from NLB microsites, NGS library, NAS archives and NHB museums in Singapore. The resulting collection retrieved comprise of books, magazine, newspaper and indexed articles, audio-visual materials, images such as photographs, drawings, stamps, paintings and posters, and archival records such as manuscripts and speeches (see Figure 3).

Figure 3: Aggregated resources indexed using KOS name of “Tan, Swie Hian” in NLB’s OneSearch platform

3. HOW KOS BUILDS TRUSTED CONTENT

To disambiguate between entities, improve accuracy of search results and facilitate discovery of contextually-linked resources on the semantic web, attributes or properties are researched and included as part of the description of the entity in KOS' name authority records. Biographical attributes of a person include a descriptive summary, birth and death dates, parents, spouse(s), children, awards, achievements, education, nationality and occupation, affiliations, corresponding Uniform Resource Identifiers (URIs) from international registries like VIAF (Virtual International Authority File) and DBpedia, image links to NLB-copyrighted photographs of the entity and sources for the content (see Figure 4). These name authority records reside in KOS's knowledge base and vocabulary management system called the Thesaurus and Taxonomy Editor (TTE).

The screenshot shows a web browser window with the URL `tte.nlb.gov.sg/pvs/headword_list_new_custom.asp?stype=kw`. The page title is "Details". Below the title, there are two buttons: "Visualize" and "Close Window". The main content area is titled "Authorised Name" and contains the following information:

- Authorised Name:** Tan, Swie Hian
- Authorised Name Details:**
 - Name:** Tan, Swie Hian
 - Name (LCNA):** Chen, Ruixian, 1943-
 - Description:** Multi-disciplinary Singaporean artist known for his poetry, novels, paintings, calligraphy and sculptures. He has won several awards in Singapore and overseas in the fields of literature, visual arts and the performing arts. He worked as a press secretary at the French embassy for 24 years after graduating from university in 1968. He retired early in 1992 to pursue the arts. He was conferred the Cultural Medallion for Visual Arts in 1987. The Tan Swie Hian Museum, established in 1993, is the first in Singapore that is dedicated to a living artist. It houses Tan's work from the 1960s to 2010s.
 - Source:** Singapore Infopedia: Tan Swie Hian (http://eresources.nlb.gov.sg/infopedia/articles/SIP_2014-03-03_130547.html) | 5 things to know about Singapore artist Tan Swie Hian (<http://www.straitstimes.com/lifestyle/visual-arts/story/5-things-know-about-singapore-artist-tan-swie-hian-20141201#sthash.fJ2qU7h.dpuf>) | Museum Roundtable: Tan Swie Hian Museum (<http://www.museums.com.sg/about-us/mr-directory/art/tan-swie-hian-museum>)
 - Birth Year (yyyy):** 1943
 - Birth Month (mm):** 05
 - Birth Day (dd):** 05
 - Parent:** Tan Chan Pok
 - Nationality:** Singaporean
 - Place of Birth:** Pulau Halang, Indonesia
 - Occupation:** Artist | Writer
 - Achievements:** A highly esteemed artist who received multiple accolades both locally and internationally in literature, visual arts and the performing arts. His first Chinese poetry collection, *The Giant* (1968), a collection of modernist avant-garde Chinese poetry was a landmark work that rocked the literary scene in Malaysia and Singapore, establishing him as a poet of standing. He was one of 98 artists selected by the United Nations to illustrate a new edition of the *Universal Declaration of Human Rights* in 1988. *Time* magazine described him as "Singapore's Renaissance Man".
 - Education:** Chinese High School | Nanyang University
 - Awards:** Chevalier de l'Ordre des Arts et des Lettres (1978) | National Book Development Council of Singapore Book Award (1978) | Cultural Medallion (1987) | Chevalier de l'Ordre Nationale du Merite (1989) | Singapore Chinese Literature Prize (1998) | Meritorious Service Medal (2003) | Officer of the Ordre National de la Légion d'Honneur (2006) | Distinguished Patron of Heritage Award (2007)
 - Affiliations(groupName):** Tan Swie Hian Museum
 - VIAF URI:** <http://viaf.org/viaf/2541038>
 - DBpedia URI:** http://dbpedia.org/resource/Tan_Swie_Hian
 - Image Link:** <http://www.nas.gov.sg/archivesonline/photographs/record-details/b7b27f2b-1162-11e3-83d5-0050568939ad> | <http://www.nas.gov.sg/archivesonline/photographs/record-details/9d24798d-1162-11e3-83d5-0050568939ad>
- Related Names:**
 - Also known as [Chen, Ruixian, 1943-](#)
 - Also known as [Tan, Swie Hian](#)
 - ENGLoCHI [陈瑞祥](#)

Figure 4: Biographical attributes of a person in Thesaurus and Taxonomy Editor (TTE)

Corporate attributes of an organisation include a descriptive summary, address, country, founder, founding year, parent organisation, awards, corresponding URIs from international registries like VIAF and DBpedia, image links to NLB-copyrighted photographs of the entity and sources for the content (see Figure 5).

The screenshot shows a web browser window with the URL `tte.nlb.gov.sg/pvs/headword_list_new_custom.asp?stype=kw`. The page title is "Details". Below the title, there are two buttons: "Visualize" and "Close Window". The main content area is titled "Authorised Name" and contains the following information:

- Authorised Name:** Singapore, National Library Board
- Authorised Name Details:**
 - Name:** Singapore, National Library Board
 - Name (Display/Name):** National Library Board
 - Description:** Statutory board established to oversee the National Library, the National Archives of Singapore, a network of public libraries, and libraries belonging to government agencies, schools and institutions in Singapore. The aim of the Board is to promote reading and learning, as well as to improve information literacy among Singaporeans.
 - Source:** National Library Board Singapore (<http://www.nlb.gov.sg/>) | Singapore Infopedia: National Library Board (http://eresources.nlb.gov.sg/infopedia/articles/SIP_2015-03-23_150155.html)
 - Street Address:** 100 Victoria Street, #14-01
 - Country:** Singapore
 - Postal Code:** 190664
 - Year Started (yyyy):** 1995
 - Month Started (mm):** 09
 - Day Started (dd):** 01
 - Parent Organisation:** Singapore, Ministry of Communications and Information (2012-)
 - VIAF URI:** <http://viaf.org/viaf/22075114>
 - DBpedia URI:** http://dbpedia.org/resource/National_Library_Board
- Related Names:**
 - Also known as [National Library Board](#)
 - Also known as [National Library Board Singapore](#)
 - Also known as [NLB](#)
 - BT [Singapore, Ministry of Communications and Information \(2012-\)](#)

Figure 5: Corporate attributes of an organisation in TTE

Geographical attributes of a place include a descriptive summary, country, longitude and latitude, feature class, feature code and feature type, corresponding URIs from international registries like VIAF, DBpedia and GeoNames, image links to NLB-copyrighted photographs of the entity and sources for the content (see Figure 6).

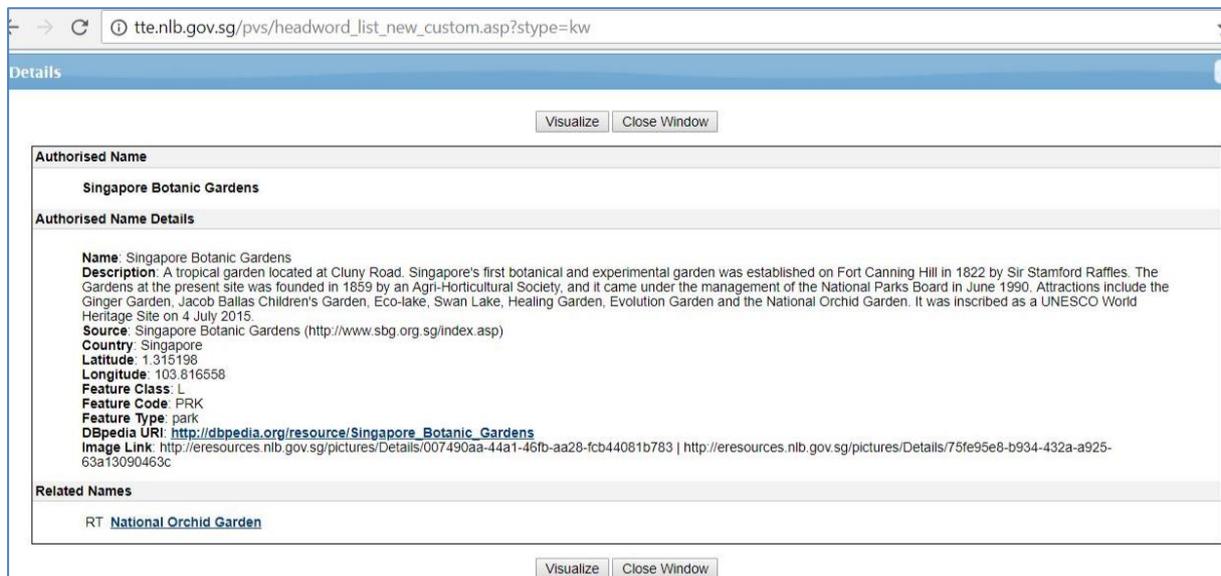


Figure 6: Geographical attributes of a place in TTE

With the rise of misinformation and disinformation, the team of NLB librarians responsible for KOS exercises due diligence and vigilance when creating local name authority records. A rigorous process of cross-validating reference sources is used to ensure the name creation of entities are unique, consistent and unambiguous. Attributes or properties of the entity are evaluated and created, relationships between entities added and variant forms of name in the four official languages of Singapore are created. Each name has its own form in English, Chinese, Malay and Tamil so that they can be used to describe resources created in these languages. Variant forms or name variations include equivalent names in different languages and aliases or pseudonyms for person entities. In order to create a comprehensive name authority record, organisational names include previous or successive forms of name as entities change their identity or their name in the course of its existence.

To achieve such rigour and in order to build authoritativeness as a single source of truth, trained librarians meticulously search through a multitude of print and online resources and factually check all information received or retrieved, especially those gleaned from crowdsourced knowledge bases such as Wikipedia. To preserve data authenticity and transparency in TTE, a standard list of authoritative print and online resources is used and maintained. Only resources acknowledged as authoritative and which have integrity and authenticity are accepted for use.

To enhance data trustworthiness, the team adheres to policy guidelines stipulating acceptable sources of data. These include publications such as "Singapore: The Encyclopedia", "Who's Who in Singapore", the country's official newspapers in the four languages and online resources such as websites of government agencies and authoritative domains ending with .gov and .edu. The inclusion of attributes such as Description attribute to describe the entity and Source attribute to capture the provenance in TTE (as highlighted in Figure 7) are made mandatory. When partners submit their resources for aggregation in TTE, they have to submit data provenance, such as database and webpage of the entity. With these measures, KOS plays

an active role to combat the misinformation epidemic and entrench itself as an authoritative source of trusted information.⁴

<p>Authorised Name</p> <p>Thumboo, Edwin</p> <p>Authorised Name Details</p> <p>Name: Thumboo, Edwin Name (ICMA): Thumboo, Edwin_1022</p> <p>Description: Singapore poet and emeritus professor at the National University of Singapore. He is best known for writing on national issues. He was awarded the Cultural Medallion for Literature in 1980, amongst other honours. Source: Singapore Infopedia: Edwin Thumboo (http://eresources.nlb.gov.sg/infopedia/articles/SIP_1329_2007-11-06.html)</p> <p>Birth Year (YYYY): 1933 Birth Month (mm): 11 Birth Day (dd): 22 Spouse: Yeo Siewe Chin Child: Julian Thumboo Claire Thumboo Nationality: Singaporean Place of Birth: Singapore Occupation: Poet Academic Active Years: 1966 Achievements: When he was Chairman/Director of the NUS Centre for the Arts (1993-2005), the Creative Arts Programme was established with the Ministry of Education, to nurture young writers. He has contributed to the development of Singapore literature as an anthologist and critic. Education: Victoria School University of Malaya National University of Singapore Awards: Southeast Asia Write Award (1979) Cultural Medallion (1980) ASEAN Culture and Communication Award for Literature (1987) Public Service Star (Bar) (1991) National University of Singapore Award for Excellent Teaching (1998) Raja Rao Award (2002) Meritorious Service Medal (2006) Affiliations(groupName): National University of Singapore NUS Centre for the Arts VIAF URI: http://viaf.org/viaf/110163099 DBpedia URI: http://dbpedia.org/resource/Edwin_Thumboo Profile Image: http://eresources.nlb.gov.sg/pictures/Details/cd8b42eb-0879-4011-ba64-f4e6b798a089 http://www.nas.gov.sg/archivesonline/photographs/record-details/a546aa74-1162-11e3-83d5-0050568939ad http://www.nas.gov.sg/archivesonline/photographs/record-details/e6ce0fb-1161-11e3-83d5-0050568939ad Image Link: http://eresources.nlb.gov.sg/pictures/Details/67094113-b6e6-40fe-b601-0b7bfd7125d5 http://eresources.nlb.gov.sg/pictures/Details/beabb2d9-2da6-41f4-97c2-10cd52882f56 http://eresources.nlb.gov.sg/pictures/Details/d5844291-ebea-4dd1-97b8-e76eb9f4d4ad http://eresources.nlb.gov.sg/pictures/Details/92d7c372-a1cc-44b6-8dbc-785df6fbded6</p> <p>Related Names</p> <p>Also known as Edwin Nadason Thumboo Also known as Edwin Thumboo Also known as Thumboo, Edwin, 1933- ENGloCHI 泰文 ENGloTAM தம்பூ, எட்வின்</p>
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Figure 7: Data provenance is captured in KOS name authority record in TTE

4. KOS AS A KNOWLEDGE BASE

As more and more entities as well as their descriptive information and relationships between entities and classes continue to be added over the years, they begin to form a knowledge base for NLB. A knowledge base provides structured data for powering knowledge discovery by means of semantics or meaning and context. The knowledge base forms the basis for semantic knowledge discovery and is a repository of information upon which the discovery functions of searching, browsing, display and access can be enhanced.

Besides names, controlled vocabularies are also created for resource description needs. These controlled vocabularies include material types, collection names and subject topics which are needed to describe resources found in the collection, whether it is NLB’s own collection or its partner collections made accessible through its search portal, OneSearch.

As it grew into a knowledge base, a need for comprehensiveness of coverage was instituted. Instead of progressing based on the needs of resource description alone, an effort was made to comb known areas of activities in the country that are perceived to be important for knowledge discovery. These include the identification of knowledge domains and the listing of classes of

⁴ Pew Research Centre (2017). “Most Americans – especially Millennials – say libraries can help them find reliable, trustworthy information”. Last accessed on May 4, 2018. <http://www.pewresearch.org/fact-tank/2017/08/30/most-americans-especially-millennials-say-libraries-can-help-them-find-reliable-trustworthy-information/>

entities within these domains such as writers, politicians, sports personalities, schools and educational institutions. KOS becomes important not only in indexing but also to complement knowledge discovery where contextual information is provided about the entities. This goes beyond the creation of names as access points in describing a resource.

An example of such a contextual service using KOS as a knowledge base is the Knowledge Panel, introduced on NLB’s search portal OneSearch in 2017. A user searching for an entity such as “Lee Kuan Yew” will be presented with information about him in a Knowledge Panel together with the search results retrieved from the collection, which also includes partners’ collections (see Figure 8).

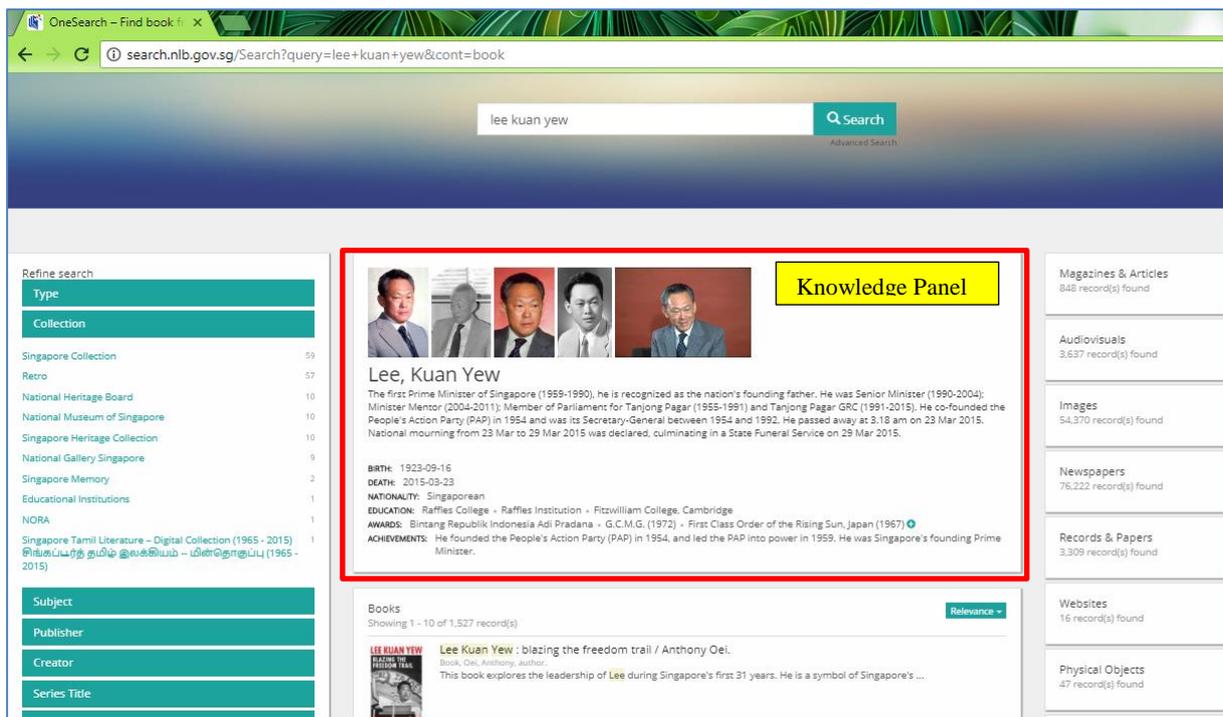


Figure 8: OneSearch’s Knowledge Panel featuring KOS name authority record from a search for “Lee Kuan Yew”.

Data for the Knowledge Panel is retrieved from NLB’s triplestore where KOS name entities and their attributes have been transformed into Resource Description Framework (RDF) triples.

5. NAMES CREATION

NLB’s policy for name creation stipulates that the names should describe Singapore and Southeast Asian-related library and archives information resources whether for public access or for digital preservation and dark archives. Local names created should be significant to Singapore’s political, economic, social, cultural or historical context. Names of personalities, organisations, monuments and landmarks are some examples. In addition, factors like authoritative, potential research value, topicality or interest as an innovative or outstanding example in Singapore’s context are also criteria for inclusion.

All Singapore entity names that fit this scope of coverage will be created and maintained even if they are already available in international registries such as LCNA or VIAF. The purpose of doing so is to centralise information about the entity in KOS for ease of use and to ensure completeness in NLB’s knowledge base of local names.

In addition to creating entity names of people, organisations and places, KOS supports NLB’s digital services by creating a controlled list of collection names and a subject taxonomy that represents the National Library’s functions and collection coverage. These support the browsing and navigation of NLB’s microsites (e.g. Infopedia, NORA, BookSG, etc.) and faceted searching in OneSearch (see Figure 9).

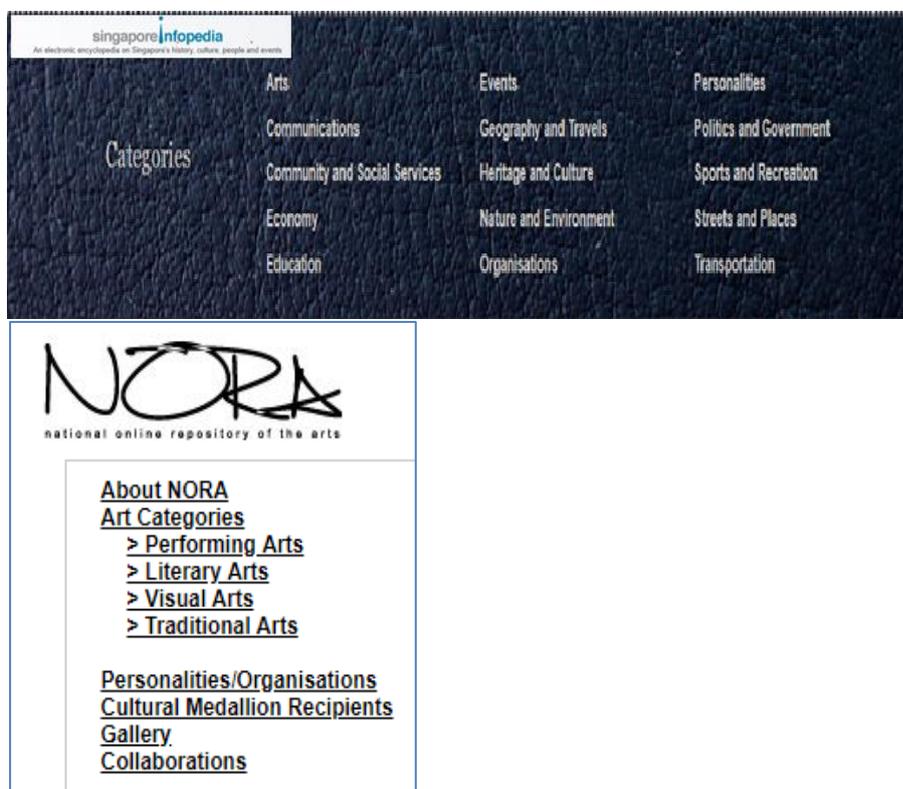


Figure 9: Taxonomy categories on NLB’s Infopedia and NORA microsites

6. DATA HARMONISATION WITH OTHER AGENCIES

Combining metadata across agencies for cross-searching without some kind of name-matching or harmonisation will cause search results to be fragmented. This is because different agencies generally use different forms of a name for a single entity. KOS links the different forms of names, regardless of changes, the use of different languages or the existence of pseudonyms and aliases. When the National Archives of Singapore (NAS) became part of NLB in March 2013, names and vocabularies needed to be harmonised and they were merged, replaced or added. Through name reconciliation, an agreement was reached with NAS to determine the authorised and non-preferred forms.

While the library follows RDA standards (Resource Description and Access; RDA Steering Committee, 2010), this is not a priority for non-libraries. For example, the library norm of using inverted names where the surname precedes the personal name separated by a comma is not a practice for institutions like the museums or the archives. To accommodate such differences when sharing names, a field in TTE where “Display Names” can be entered was created, so these names can be used for display even if they are the non-preferred names.

There are many other challenges when standardised names are shared with other agencies. The following are examples of name creation practices which were reviewed as a result of the data harmonisation process:

i. Combo Names – People and Organisations

Where multiple entities are combined to form combined names e.g. “Mr and Mrs Law Ah Teck” and “Barry G and Barbara J Smith”. As the best practice is to uniquely identify individual entities for specificity and granularity of description, such combo names were split into individual name authority records. This helps to improve precision in discovery and will also help to facilitate processes such as automatic indexing where individual names stand a better chance of being indexed when they become part of the data dictionary used in such processes.

Similarly, the practice of combining two or more agencies together as one name authority record, which are then indexed as a single entity e.g. “Ministry of Health, Central Provident Fund Board” was reviewed and the two entities separated so that both can be used to index the document.

ii. Anonymous Names

Due to confidentiality needs, the actual names of creators or contributors of certain resources were not assigned for some records. Instead, non-specific terms such as “Anonymous” was used in place of the actual names. However, such terms cannot be created in KOS as name authorities of people or organisations. As such, the indexing system’s “Authority Record” module was enhanced to enable staff to click “Yes” if they choose to have a name displayed as “Anonymous” (see Figure 10).

The screenshot shows a web form titled "Add Authority Record". At the top, it states "Fields marked by an asterisk * are mandatory" and "Click [here](#) to show or hide descriptions".

The "Identity area" section contains several fields:

- "Type of entity *": A dropdown menu.
- "Authorized form(s) of name*": A text input field with a "Save" button to its right. Below it is the instruction: "To create an authorized access point that uniquely identifies a corporate body, person or family".
- "TTE Group": A text input field with the instruction: "Indicates the TTE group that the authority belongs to.".
- "Parallel and Other forms of name": A text input field with the instruction: "To indicate any other name(s) for the corporate body, person or family not used elsewhere in the Identity Area eg. Acronyms, Past names etc.".

Below the "Identity area" is a section for "Display Name" with radio buttons for "Yes" and "No".

At the bottom, there is a table titled "Display Names *":

Name	Visible?	Order
PERDAUS	<input type="checkbox"/>	<input type="text"/>
Adult Religious Students Association Singapore	<input type="checkbox"/>	<input type="text"/>
Persatuan Pelajar-Pelajar Agama Dewasa, Singapura	<input type="checkbox"/>	<input type="text"/>

Below the table is the instruction: "Indicates visibility and order of names/aliases to be displayed in Archives Online. Name with order '1' will be the first name to be displayed in Archives Online. This will be followed by other names in ascending order, separated by semi-colons."

Figure 10: How to accommodate confidentiality by assigning “Anonymous” as Display Name

7. NLB'S NAME AUTHORITIES SHARED WITH WHOLE OF GOVERNMENT

From feedback received from its partners, the KOS team began to recognise that the local name authority records with their attributes, relationships and variations of names, specifically of People, Organisations, and Places, may be valuable and should be shared with other agencies in the Singapore government. As an example, one of our partners NHB, has found these names useful for their indexing and has been actively using these names for their resource description, while at the same time contributing more names to NLB's database. Another agency has requested a download of KOS names as a data dictionary for their speech corpus.

By sharing these names, other government agencies save time and resources by not needing to create and maintain their own lists. In the long run, there is also potential to improve whole of government search results if consistent indexing using NLB's name authorities is achieved across agencies.

NLB can provide leadership in the area of name creation standards and control with other agencies. It can share best practices and promote the use of standardised names. It can also potentially aggregate separate lists of names created by other agencies into a single source of reference. To this end, NLB has recently made its Name Authorities accessible for use by other government agencies (see Figure 11).

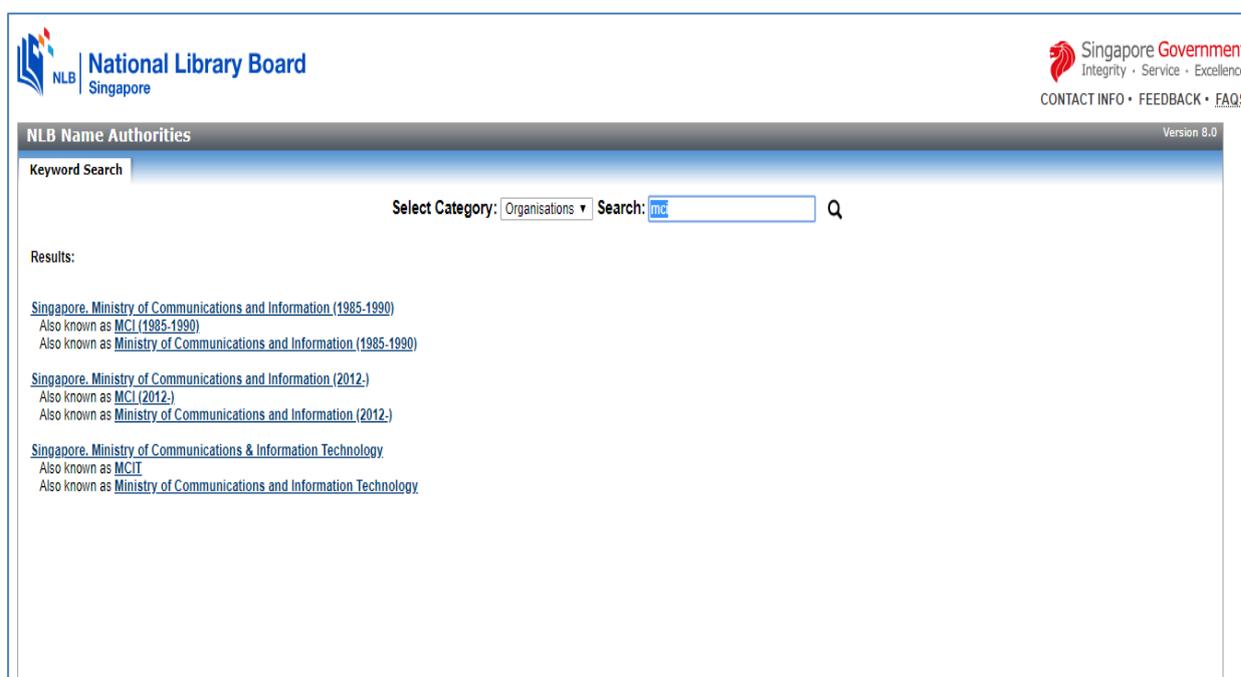


Figure 11: Simple user interface for KOS sharing with the whole of government

8. PUBLISHING OF NAMES IN VIAF

VIAF (<http://viaf.org/>) is an international name authority registry hosted by OCLC which aims to place multiple name authority files (including people, organisations and places) under one roof, represented by a URI. The objective of VIAF is to increase the use of library authority files by matching and linking widely-used authority files and making that information available on the Web.

In our effort to expose Singapore names to the global community, we have published names of Singapore personalities, organisations, and places on VIAF. Names selected for VIAF publishing are usually of Singapore’s prominent or significant personalities, landmarks and monuments. Institutions of cultural, heritage & national importance are also included (see Figure 12 for examples).

Organisation	People
<p>Central Fire Station, Singapore </p> <p>Caserne centrale de pompiers (Montréal, Québec) </p> <p>中央消防局 (新加坡) </p> <p>Balai Bomba Central (Singapura) </p> <p>மத்திய தீயணைப்பு நிலையம் (சிங்கப்பூர்) </p> <p>VIAF ID: 304573118 (Geographic) Permalink: http://viaf.org/viaf/304573118</p> <p>Preferred Forms</p> <ul style="list-style-type: none"> 151 __ _ta_Balai Bomba Central (Singapura) 110 2 __ _ta_Caserne centrale de pompiers (Montréal, Québec) 151 __ _ta_Central Fire Station (Singapore) 110 2 __ _ta_Central Fire Station (Singapore) 151 __ _ta_Central Fire Station_Singapore 151 __ _ta_மத்திய தீயணைப்பு நிலையம் (சிங்கப்பூர்) 151 __ _ta_中央消防局 (新加坡) 	<p>Kunalan, C. 1942- </p> <p>Kunalan, C. (Canagasabai), 1942- </p> <p>Canagasabai Kunalan Singaporean sprinter </p> <p>古纳兰 1942- </p> <p>சி. குணாளன் 1942- </p> <p>VIAF ID: 120546061 (Personal) Permalink: http://viaf.org/viaf/120546061</p> <p>Preferred Forms</p> <ul style="list-style-type: none"> 100 0 __ _ta_Canagasabai Kunalan tc_Singaporean sprinter 100 1 __ _ta_Kunalan, C. td 1942- 100 1 __ _ta_Kunalan, C. td 1942- 100 1 __ _ta_Kunalan, C. tq (Canagasabai) td 1942- 100 1 __ _ta_Kunalan, C. tq (Canagasabai) td 1942- 100 0 __ _ta_சி. குணாளன் td 1942- 100 0 __ _ta_古纳兰 td 1942-

Figure 12: Examples of NLB Authorities published on VIAF

9. APPLICATIONS AND SERVICES SUPPORTED BY KOS

To tap on the KOS knowledge base, we developed a web service to allow consuming applications to query TTE database. This service queries all data elements including associations and variant forms such as “Display Name”.

Consuming applications such as OneSearch and websites such as NAS’ Archives Online will be able to call the web service to “expand and increase” a search so that relevant content will be retrieved in spite of the different names by which an entity is known by, or the different forms in which the public may enter a name, such as for:

- Lee Kuan Yew and his Chinese name 李光耀
- Lim Bo Seng⁵ and his alias of Tan Choon Lim
- Telok Ayer Market⁶ and its colloquial name of Lau Pa Sat
- SPRING Singapore⁷ and its former name of Productivity and Standards Board and related name of Enterprise Singapore

⁵ Major-General Lim Bo Seng (b. 27 April 1909, Nan Ann, Fujian, China - d. 29 June 1944, Perak, Malaya) was a prominent Hokkien businessman who undertook active leadership in anti-Japanese activities during World War II and is recognised as a local war hero in Singapore.

⁶ The former Telok Ayer Market (now known as Lau Pa Sat, meaning “old market”) at Raffles Quay was completed in 1894. It was gazetted as a national monument on 28 June 1973 and converted into a food and entertainment complex in 1989.

⁷ SPRING Singapore, a statutory board under the Ministry of Trade and Industry, aims to raise productivity to enhance Singapore’s competitiveness and economic growth. SPRING stands for Standards, Productivity and Innovation for Growth. It was renamed SPRING Singapore in April 2002 from the former Productivity and Standards Board (PSB). It was renamed as Enterprise Singapore after its merger with International Enterprise Singapore in April 2018.

As mentioned in section 2 of this article, NLB has transformed KOS data into Linked Data. To do this, we created an ontology called the NLB data model (NLBDM), based on the Library of Congress' BIBFRAME model. KOS authority data and bibliographic data including those from NAS and NHB were transformed into RDF using NLBDM. A service was conceptualised that allowed multi-dimensional entry points for the exploration of entities and contextual browsing of linked resources. Patrons can access Linked Data regardless of source from a single interface. Figure 13 demonstrates how clicking on the images in NLB's Linked Data Entity Page (eresources.nlb.gov.sg/linkedata) will bring patrons to the photograph on Archives Online⁸ or NLB's PictureSG⁹ website, while links under "Works By" would bring patrons to related books in the OPAC and articles or digitised materials from the digital collection.



Figure 13: KOS Data in NLB's Linked Data Entity Page

SYNOPSIS
 Prime Minister of Singapore (1959-1990); Senior Minister (1990-2004); Minister Mentor (2004-2011); Member of Parliament for Tanjong Pagar (1955-1991) and Tanjong Pagar GRC (1991-). Helped found the People's Action Party (PAP) in 1954 and was its Secretary-General between 1954 and 1992. Passed away at 3.18 am on 23 Mar 2015. National mourning from 23 Mar to 29 Mar 2015 was declared, culminating in a State Funeral Service on 29 Mar 2015.

BIRTH
 1923-09-16

ACHIEVEMENT
 Founded the People's Action Party (PAP). Led PAP into power in 1959. Singapore's founding Prime Minister.

DEATH
 2015-05-23

AWARD
 First Class Order of the Rising Sun, Japan
 C.H.
 G.C.M.G. | Bintang Republik Indonesia Adi Pradana
 Freedom of the City of London
 The Most Honourable Order of the Crown of Johore, First Class | The Most Esteemed Family Order DK Brunei | The Darja Kerabat Laila Utama

<p>ABOUT</p> <p>Lee Kuan Yew</p> <p>Premiership of Lee Kuan Yew</p> <p>Showing 1 to 2 of 2 entries</p>	<p>MEMORIES</p> <p>Screen displaying image of Lee Kuan Yew at the National Day Parade, 2002</p> <p>向李光耀致敬</p> <p>李光耀談新加坡的華人社会 = Lee Kuan Yew on the Chinese community in Singapore</p> <p>Official opening of the Singapore Polytechnic's Dover Road campus by Prime Minister Lee Kuan Yew, 7 Jul. 1979. Mr Lee K</p> <p>Khee Fatt School Opening speech by Prime Minister Mr Lee Kuan Yew</p> <p>Showing 1 to 5 of 16 entries</p>	<p>WORKS BY</p> <p>மகேசுவர மலர்ந்தது</p> <p>STATEMENT BY THE PRIME MINISTER, MR. LEE KUAN YEW, AT THE ANNOUNCEMENT OF THE ELECTIONS RESULTS AT 11.30 P.M., APRIL 13</p> <p>MESSAGES FROM HEADS OF STATE TO THE PRIME MINISTER ON THE COLLAPSE OF HOTEL NEW WORLD</p> <p>SPEECH BY THE PRIME MINISTER, MR. LEE KUAN YEW, AT THE INAUGURATION OF THE "KEEP SINGAPORE CLEAN" CAMPAIGN ON TUESDAY, O</p> <p>Perjuangan untuk menegakkan Malaysia berbilang-bangsa Malaysian /</p> <p>Showing 1 to 5 of 249 entries</p>	<p>RELATED SUBJECT</p> <p>Singapore</p> <p>Personalities>>Biographies>>Leaders</p> <p>Politics and Government</p> <p>Pioneers--Singapore--Biogra</p> <p>Politicians</p> <p>Showing 1 to 5 of 181 entries</p>
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⁸ National Archives of Singapore. "Archives Online". Last accessed on May 4, 2018.

<http://www.nas.gov.sg/archivesonline/>

⁹ National Library Board. "PictureSG". Last accessed on May 4, 2018. <http://eresources.nlb.gov.sg/pictures>

As an access point to the Entity Page in Figure 13, a widget was created (see Figure 14). The widget allows patrons to perform contextualised searches based on entities found on content websites where the widget is embedded.

Using named-entity recognition where KOS data was used as a data dictionary, entities extracted from four classes (Events, People, Places, Organisations) were linked to information from NLB’s triple store. As a source of input, any new named entities extracted were disambiguated into the four classes and added into KOS.



Figure 14: Linked Data widget

KOS data in its RDF form are made available on NLB Labs (<http://www.nlb.gov.sg/labs/mash-create-collaborate/>), its platform for collaboration with industry players and individuals interested in creating services and applications using NLB’s open data (see Figure 15).

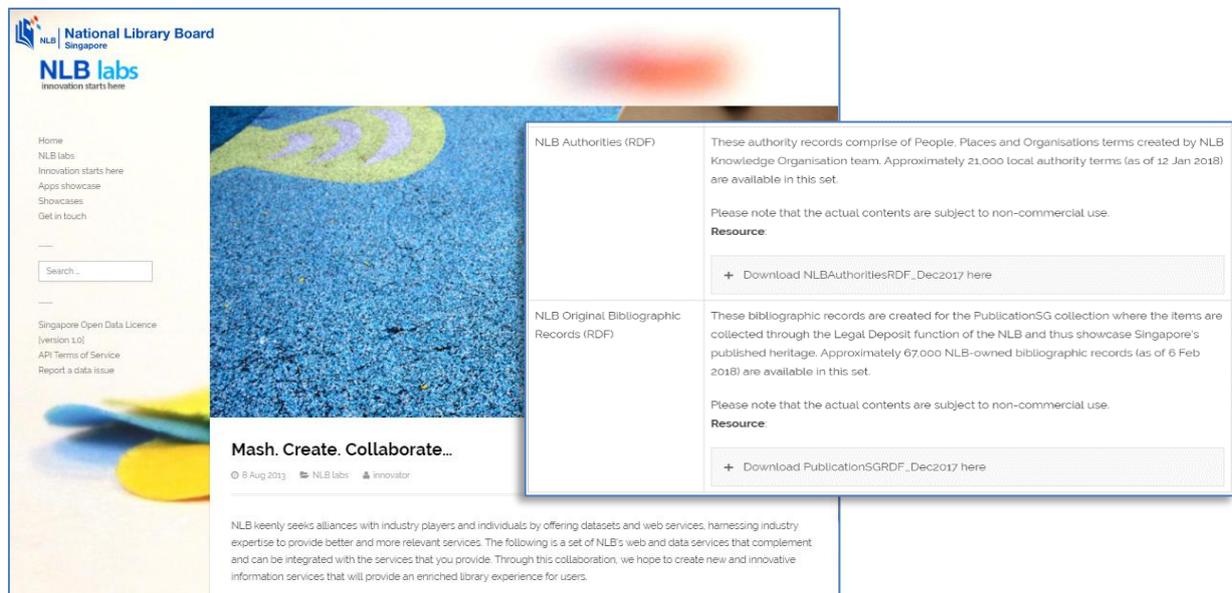


Figure 15: NLB Labs ‘Mash. Create. Collaborate’ main page and RDF datasets.

10. CONCLUSION

KOS name authority records have hitherto been used with confidence to support NLB’s indexing, applications and services and its value as a knowledge base is thought to be of use to others outside of NLB. We are sharing its use with Singapore government agencies, while simultaneously making the data available on international registries and as open data for developers. In response to the United Nations 2030 agenda of providing trusted and authentic content for all, we envisage that KOS name authorities can be made accessible to other libraries and repositories with Singapore or Southeast Asian-related content resources. To this end, plans are underway to provide entity URIs on our whole of government sharing platform and a Linked Data URI browser that will enable KOS data to be shared and RDF queries to be made on the world wide web.

About the Authors

Tang Puay Eng is a Senior Librarian with the Resource Discovery Department in the National Library Board of Singapore. She is responsible for the development and maintenance of Singapore name authorities and taxonomies. She has previously worked in a public library, a national library and in technical services, performing duties ranging from serving public and corporate clients, project management to indexing. She has presented on her work on developing collaborative reference services in international conferences, such as Internet Librarian International and Libraries in the Digital Age.

Glenn Hong is a Senior Manager in the Resource Discovery Department in the National Library Board of Singapore. He is responsible for the creation and maintenance of Singapore name authorities and taxonomies. He has previously worked in a public library, a special library, and in technical services, performing roles in collection development, reference services, and cataloguing.

Haliza Jailani is a Deputy Director in the Resource Discovery and Management division of the National Library Board of Singapore. She is responsible for the Resource Discovery portfolio of cataloguing and metadata creation, KOS and ontology support and information discovery using metadata. She has previously worked in a public library, as a cataloguer, in a service development capacity and served as one of NLB's pioneers in Digital Library developments. She is currently a member of IFLA's Linked Data Sub-Committee.

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