### EMPOWERING USER DISCOVERY WITH LINKED DATA AND SEMANTIC WEB TECHNOLOGIES

### Ee, Min Hoon

Senior Librarian Resource Discovery and Management Resource Discovery





## **OVERVIEW**

- Background
- Problem Statement
- Linked Data Management System
- Implementation of the Singapore Infopedia Widget
- Challenges
- Future Plans
- Conclusion



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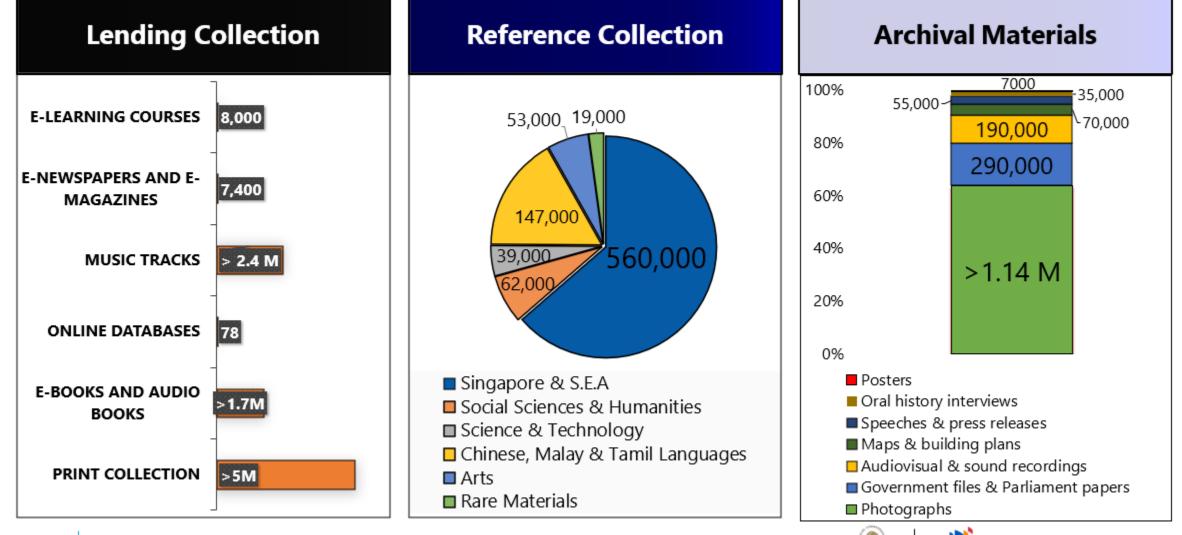


### **National Archives**

- Collects, manages and preserves public and private archival records
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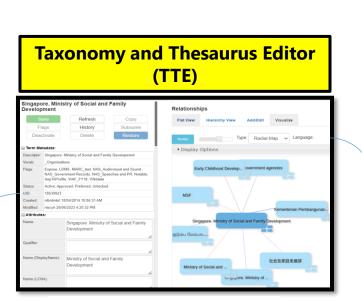
### **SOURCES OF METADATA**

#### **Public Libraries and National Library Physical Collection** Q Search New Arrivals (This Week) TIME AND TU 怎样说,孩子才会主动学 | Zen 东京攻略完全制器 2025-2026 The penguin waltz yang shuo, hai... Dongjing gon... Malacee Oli Of time and turtles : mending The Millicent Quibb School of The wrest duke in London WIRW | Salt. Tomo ME-OILIN Warn

Integrated Library Management System (ILS) MARC21

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Music Albums, Lyrics and Scores (31208)	By: Ang, Seow Leng , Published: 12 Mar 2024		
UMans (829)	One of Singapore's oldest charitable healthcare institutions, Kwong Wal Shiu Hospital (KWSH) was founded New	ed Help? × 👥	

Content Management System (CMS) DUBLIN CORE



#### LOCAL AUTHORITY DATA in CSV



Archives Online Indexing System (AO) DUBLIN CORE



## RECORD BASED FORMAT HINDERS DISCOVERY

# Users' discovery journey is limited or need to be done using several systems and platforms.



7 82 %

No Result.

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### LINKED DATA MANAGEMENT SYSTEM (LDMS)

### Centralized Knowledge Graph

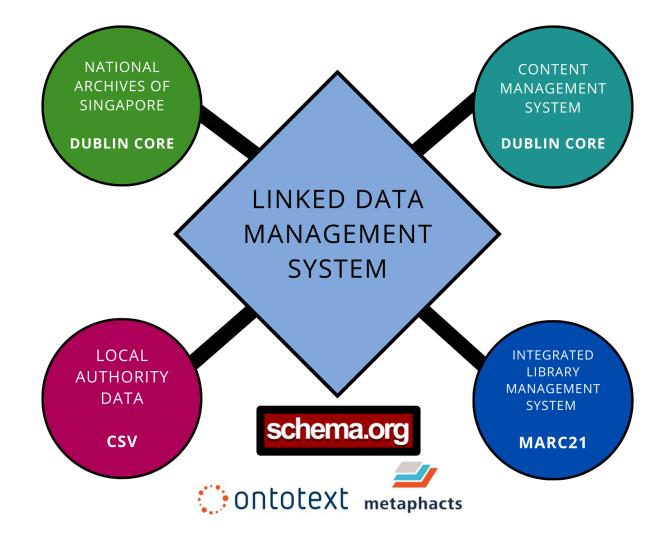
- Unifies data from National Library, Archives, and Public Libraries
- Beyond keyword searches; discover known and unknown resources

### Flexible Management

- Supports MARC-XML, DC-XML, CSV
- Automatic and manual updates

### Schema.org Standards:

• Web-friendly, easily discoverable data

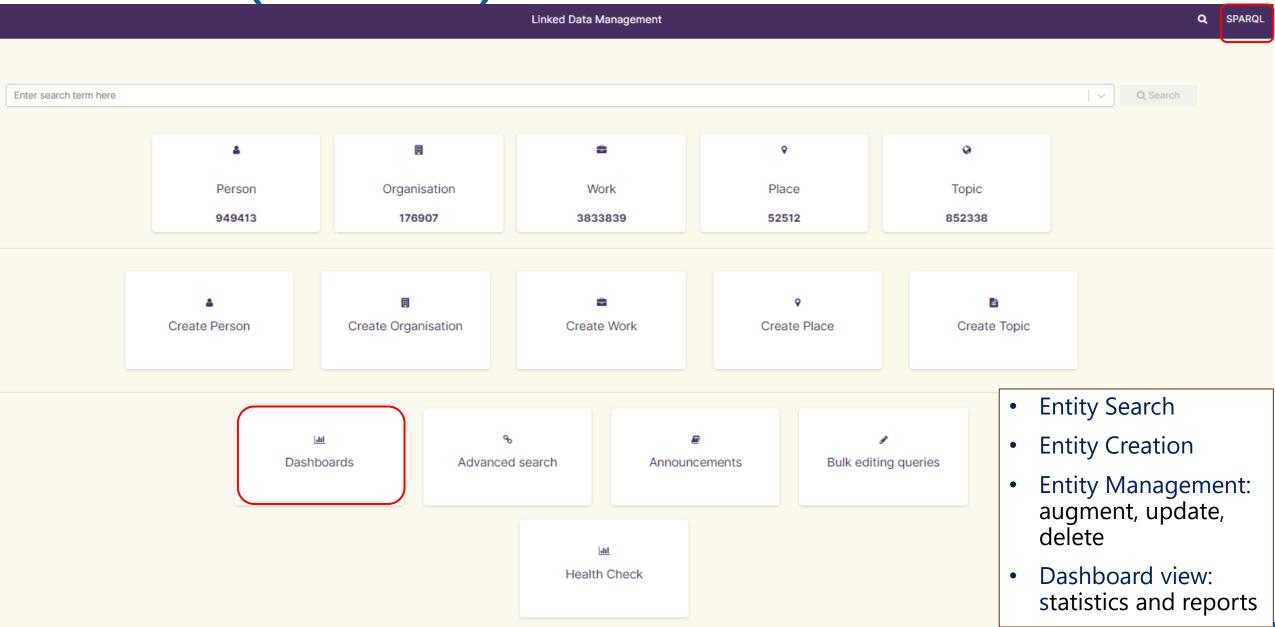




### **DATA MANAGEMENT INTERFACE**



### LINKED DATA MANAGEMENT SYSTEM: DATA MANAGEMENT INTERFACE (BACK END)



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#### Birth Date 😯

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#### Birth Place 😮

13



Raffles, Thomas Stamford, Sir MODIFIED

Export -

Create entity -

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

NLB-TTE: 18338326 📋





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)
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- Sir Thomas Stamford Raffles (TTE)

#### Alternative name

- Thomas Stamford Raffles (TTE)
- Stamford Raffles (TTE)
- ராஃபில்ஸ், தாமஸ் ஸ்டாம்ஃபோர்ட் (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)

#### Nationality

British (TTE)



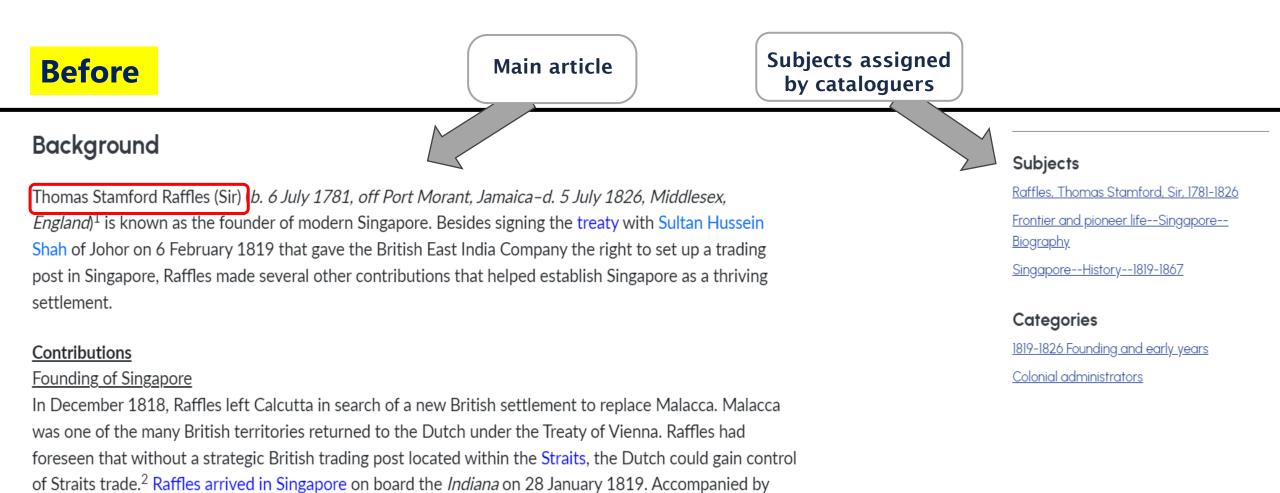
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## IMPLEMENTATION OF THE SINGAPORE INFOPEDIA WIDGET



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## **CURRENT INFOPEDIA ARTICLES LEAVE USERS** WANTING MORE RELATED CONTENT



National Library Board

William Farguhar and a sepoy, he met Temenggong Abdul Rahman to negotiate for a British trading post to

### PRIMARY OBJECTIVES OF THE SINGAPORE INFOPEDIA WIDGET



1.To enhance user discovery of related resources within NLB's extensive collection

2.To leverage the Linked Data Knowledge Graph for improved content recommendations

3.To provide a seamless and intuitive user experience for exploring interconnected information

4.To support researchers and students in their informationseeking processes



### LINKED DATA INFOPEDIA WIDGET

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right of the statue. Title devised by Library staff.					You May Also Like		You May Also Like
After	01 / 01				You are currently on: Raffles, Thomas Stamford, Sir, 1781-1826		You are currently an: Raffles, Thomas Stamford, Sir, 1781-1826
	ary 1819. Travelling on the <i>Indiana</i> with a squadron th Abdul Rahman. <sup>1</sup> The site on the Singapore mainland wh . <sup>2</sup>				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 Februa See more		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 Februa See more
According to a 13 February 1819 letter written b asking if the Dutch had authority over the main i	by Raffles, a delegation from Singapore boarded the <i>Ind</i> sland, and noted that only the Temenggong held fort t next morning on the 29th, planted the Union Jack, an	here. Later that same evening, Raffle	es and William Farquhar went ashore		Learn More Related Topics Birth date: (edtf) 1781-07-03 Dicth class inc.		Learn More Related Topics Geography and Travels Interpretation 1819-1826 Founding and early years
The Temenggong, a vassal of Sultan Hussein, was dispatched and instructions left for a fort to be b treaty on 6 February. Raffles departed Singapore		Birth place: Jamaica Death date: (edtf) 1826-07-05 Occupation: Statesman Also known as: Lai-fo-shih, 1781-1826 , Raffles,		<ul> <li>Culture and heritage</li> <li>Colonial AdministratorsSingapore</li> <li>Singapore History 1819-1867</li> <li>Temenggong Abdul Rahman</li> </ul>			
Timeline			-		Related Resources		🛓 Gibson-Hill, Carl Alexander
27 Jan 1819: The Indiana rendezvous with the D discussion, they decide against it and head toward		urveying the possibility of the Karim			Read (431)		Abdullah, Munshi     Farquhar, William 1774-1839     Chow, Ah Chey
	at St John's Island. Raffles and Farquhar meet the Tem- een the Temenggong and the British, and the Union Jac from Riau. <sup>11</sup>				Sir Thomas Stamford Raffles		<ul> <li>Fort Canning Hill</li> <li>Singapore</li> <li>Parliament House (Singapore)</li> </ul>
appointed Resident and Commandant under the	veen Raffles, the Sultan and the Temenggong, with com authority of Raffles, the Lieutenant-Governor of Benc however, from Raffles's mistake in recording the date cause 1819 was not a leap year. <sup>13</sup>	oolen. The Union Jack is officially ra	sed. This date is recognised as the official		This other India : a biography of Sir Thomas Stamford Raffles		<ul> <li>Bencoolen</li> <li>Kallang Basin</li> <li>Rochor River</li> </ul>
They were entertained with fruits, including ram remained by the shore, living in makeshift attap I Abdullah, both of whom were paid 500 pounds f	rents, testified that in the morning, Raffles arrived in th butans, at the Temenggong's home, leaving at about 4. huts. Tunku Long was found fishing in the Straits of Rh for their effort. Upon his arrival, the Tunku conducted r	00 pm that afternoon. <sup>14</sup> The British io by two princes, Raja Ombong, the	then left, returning 12 days later, but they former's kinsman, and Enche Wan		Obituary : Sir Thomas Stamford Raffles		St John's Island Related Resources Read (431) Sir Thomas Stamford Raffles
Raffles's, which was located in Padang Senar. <sup>15</sup>		Destricted			Previous 1 2 144 Next	Na	tional Library Board

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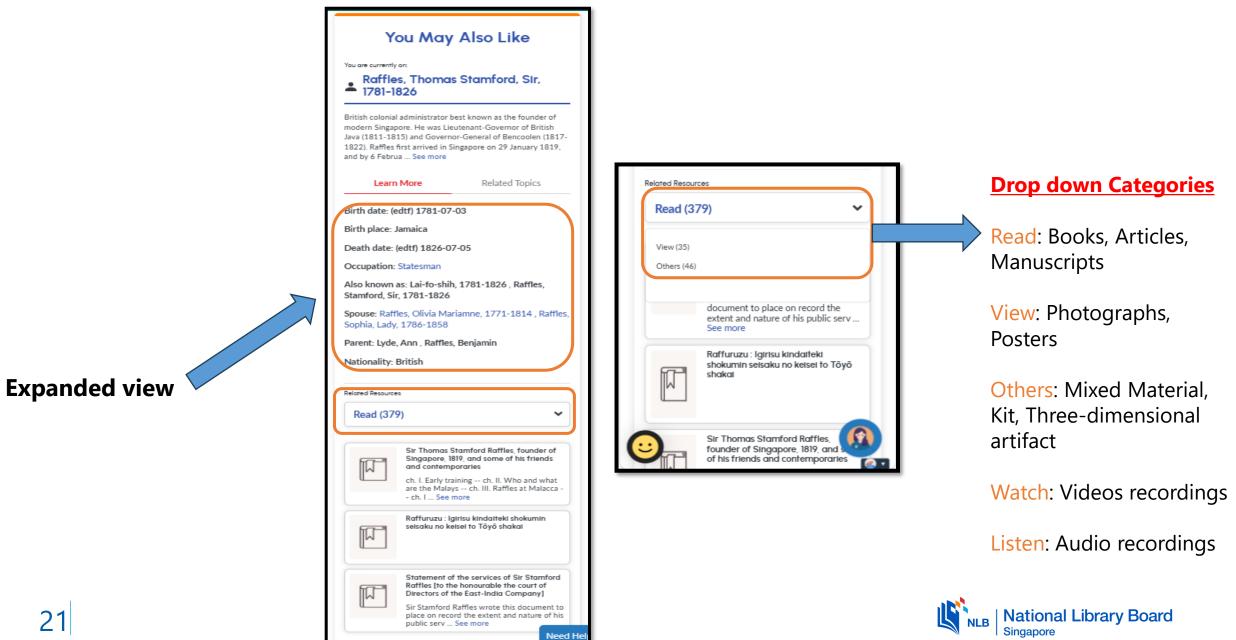


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Birth date: (edtf) 1781-07-03 Birth place: Jamaica Death date: (edtf) 1826-07-05	Click to expand view	<ul> <li>Singapore History 1819-1867</li> <li>Colonial administratorsSingapore</li> <li>Abdul Rahman</li> </ul>	interest related to the content of th
Occupation: Statesman Show More Results Related Resources	Toggle between resource types	<ul> <li>Farquhar, William, 1774-1839</li> <li>Chow Ah Chey</li> <li>Rochor River</li> <li>Kallang Basin</li> <li>Parliament House</li> </ul>	page
Read (379) Sir Thomas Stamford Raffles, founder of Singapore, 1819, and some of his friends and contemporaries ch. I. Early training ch. II. Who and what are the Malays ch. III. Raffles at Malacca - - ch. I See more	Top 3 suggested resources. Links lead to the resource in the respective service eg ILS	<ul> <li>Fairlanent House</li> <li>St John's Island</li> <li>Bencoolen</li> <li>Fort Canning Hill</li> <li>Gibson-Hill, C. A. (Carl Alexander)</li> <li>Abdullah, Munshi, 1796-1854</li> </ul>	
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Birth date: (edtf) 1781-07-03

Birth place: Jamaica

Death date: (edtf) 1826-07-05

Occupation: Statesman

Also known as: Lai-fo-shih, 1781-1826 , Raffles, Stamford, Sir, 1781-1826

Spouse: Raffles, Olivia Mariamne, 1771-1814, Raffles, Sophia, Lady, 1786-1858

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Nationality: British

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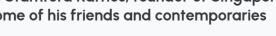
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What's On

Sir Thomas Stamford Raffles, founder of Singapore, 1819, and some of his friends and contemporaries

#### DIGITISED BOOR 1918

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#### Information About

The author culls from various sources, such as Lady Raffles's "The life of Sir Stamford Raffles", Munshi Abdullah, letters from and to Raffles' close friends, Dr John Leyden, an orientalist, scholar and poet, William Marden, an oriental scholar, missionaries, Dr. Morrison and Dr. William Milne and others, to describe Sir Stamford Raffles's character, life, work and accomplishments as the founder and adminstrator of Singapore and his contribution to education and natural history.

Raff	uruzu : Igirisu laiteki shokumin aku no keisei to o shakai / Shinobu	<b>ki shokumin seisaku</b> 1909-1992   Shinobu, Seizabur	植民政策の形成と東洋 no keisei to Tōyō shal ō, 1909-1992		ı : Igirisu	Share Bookmark Options
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Photograph



## LEADING USERS ON A JOURNEY OF SERENDIPITOUS DISCOVERY



24

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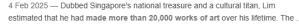
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One of Singapore's most revered artists, Lim Tze Peng has gained recognition for highlighting the effects of rapid modernization by

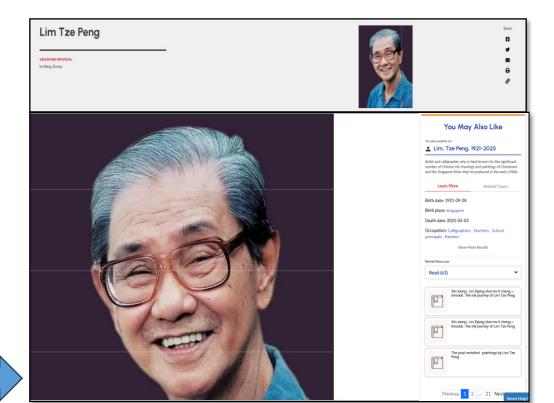
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#### Lim Tze Peng - Singapore

by Z Wang - Lim Tze Peng (林子平) (b. 28 September 1921, Singapore-d. 3 February 2025, Singapore) was an artist and a Cultural Medallion recipient in 2003.<sup>1</sup> Self-taught,







Lim Tze Peng (林子平) (b. 28 September 1921, Singapore-d. 3 February 2025, Singapore) was an artist and a Cultural Medallion recipient in 2003.<sup>1</sup> Self-taught, Lim started painting in the 1950s when he was a teacher in Xin Min School.<sup>2</sup> A: result of his strong foundation in Chinese philosophy, art and culture, his paintings are often deeply rooted in tradition and yet exude a contemporary feel.<sup>3</sup> He passed away in 2025 at the age of 103 after being hospitalised for pneumonia:

#### Early life

The eldest of seven children, Lim was born in 1921 in a kampong in Pasir Ris. His parents were farmers who reared pigs and chickens and tapped rubber trees.

Lim was educated at Guangyang Primary School and Chung Cheng High School. It was during this period when his love for Chinese calligraphy and oil painting was cultivated under the tutelage of art teachers such as Lu Heng. Gao Peize, Wong Jai Ling and Yeh Chi Wei. In calligraphy, Lim was much influenced by master calligrapher, Kang Youwei, and Kang's discussion of the aesthetics of Chinese calligraphy in one of his works. Guang Yi Zhou Shuang Ji (广艺舟双相划, <sup>6</sup> Lim's ink paintings, on the other hand, were heavily influenced by Huang Bin Hong.

Lee took up teaching in Xin Min School in 1949. He became the school's principal in 1951 and remained in the position until 1981.

Lim is known for "Muddled Writing" (關途字), his series of calligraphy during the late 2000s, which helmed a new stylistic discourse in which form takes precedence over the meaning of the characters. He was also recognised for his "Colour Calligraphy", which are calligraphic expressions that involve the use of colour pigments - a practice uncommon in traditional Chinese calligraphy.

Lim participated actively in artist field trips around the Southeast Asian region, especially in the 1960s to 1970s with the Ten Men Group.<sup>10</sup> His well-known Bali series was painted during such field trips, mostly in the 1970s and 1980s. The 1970s pieces are recognised by broad washes of opaque, glasslike ink, harmonised with looser compositions as compared to those painted in the 1980s, which are characterised by brisk, deft and definitive lines.11

Lim is also known for his Chinese ink paintings of Chinatown and the Singapore River in the early 1980s, when urban redevelopment focused on these two areas.<sup>1</sup>

#### Accomplishments

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Lim participated in a number of solo and group exhibitions.<sup>13</sup> His first solo exhibition was held in 1970. Since then, he has exhibited his works widely, both in Singapore and abroad. In 2009, he became the first Singaporean to have a solo exhibition at the National Art Museum of China.<sup>5</sup>

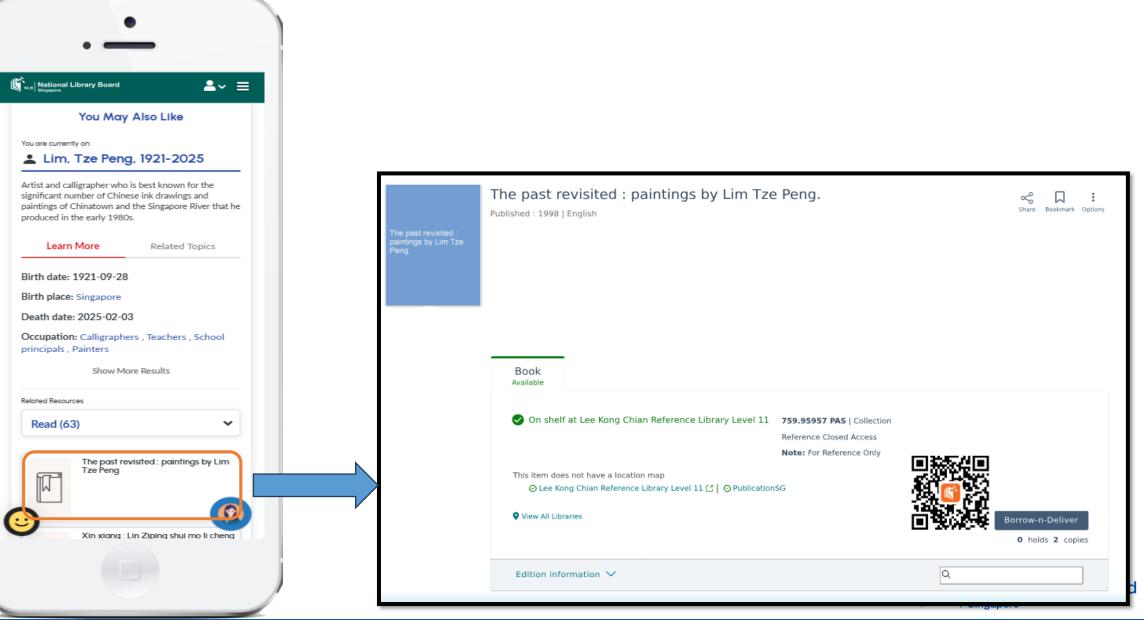
Through donations made by Lim and collectors of his art, a large number of his works have entered the Singapore Art Museum and the Nany

For his contributions to art, Lim received several awards, including the Cultural Medallion in 2003.16

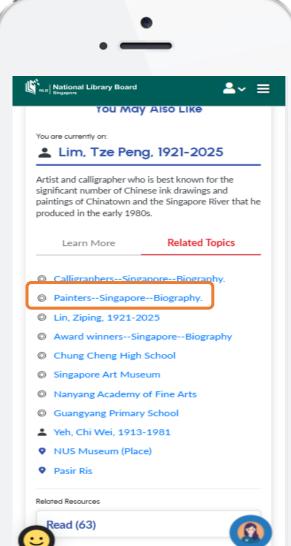


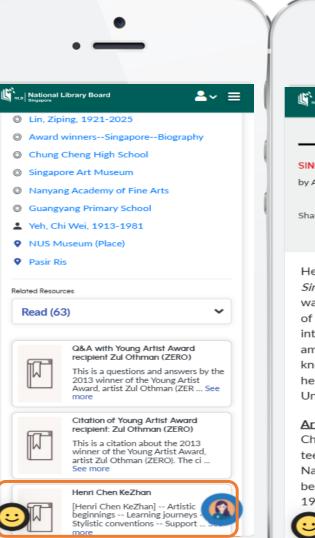
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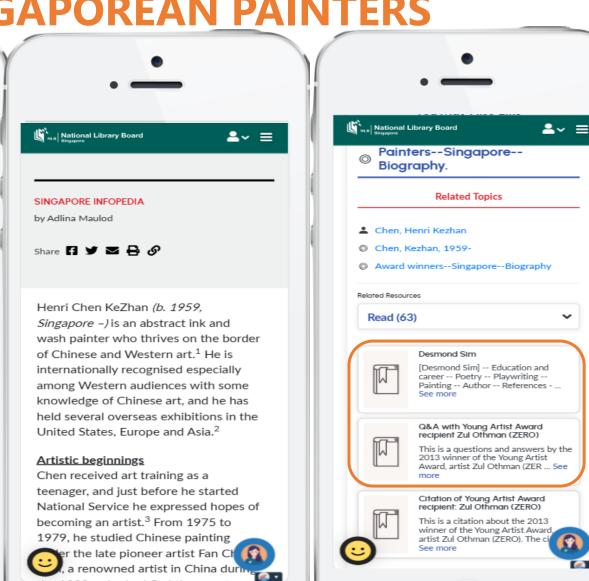
### SEARCHING FOR "LIM TZE PENG" ON GOOGLE LEADS TO WORKS ABOUT HIM [VIEW FROM MOBILE DEVICE]



### SEARCHING FOR "LIM TZE PENG" ON GOOGLE LEADS TO OTHER FAMOUS SINGAPOREAN PAINTERS







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Lim, Tze Peng, 1921-2025	Singapore's oldest art academy, with Lim Hak Tai as its founding principal. Currently spans four campuses	Legacy: Leong Yoon Pin -
significant number of Chinese ink drawings and paintings of Chinatown and the Singapore River that he produced in the early 1980s.	along Bencoolen Street.  Learn More Related Topics	Nanyang Academy of Fine Arts Fonds Fonds/Collection
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NUS Museum (Place)		may require 7 working days.
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Related Resources	Hao ge mel qu xian guo qing : 3	Synopsis : This CD contains a live recording of some of the unpublished and critical works by the late composer and
		musical talent Leong Yoon Pin. Performed by the faculty, alumni and music students of School of Music, it showcases a gamut of the late doyen's masterpieces, from the eclectic 'Interfusion for Piano Quintet' to 'Sketches for Oboe and Piano', a piece inspired by scenes of volcanic activity encountered during Mr Leong's fravels to New Zealand. This recording produced by the Institute of Southeast Asian Arts at Nanyang Academy of Fine Arts (NAFA) serves as a tribute to a dedicated musician and educator who was instrumental

in setting up the Department of Music at NAFA in 1984

### SEARCHING FOR "LIM TZE PENG" ON GOOGLE LEADS TO "LEONG YOON PIN"

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Singapore's oldest art academy, with Lim Hak Tai as founding principal. Currently spans four campuses along Bencoolen Street.	Composer, conductor and music educator renowned for his choral compositions. He is regarded as the "Father of Singaporean composers". For his contributions to music, he was awarded the Cultural Medallion in 1982.	Related Resources Listen (32)	View Lyrics
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Leong, Yoon Pin Cultural Medallion	Birth date: 1931-08-05 Birth place: Singapore	Digitised from the original source, this track is from the album 'Myriad voices'. The music is compo See more	
Liang, Rongping	Death date: 2011-04-13		
<ul> <li>ComposersSingaporeBiography.</li> <li>Award winnersSingaporeBiography</li> </ul>	Occupation: Composer , Conductor (Music) , Music teacher	欢迎你们远方的朋友 钢琴:苏恒&刘笑恒	
National Institute of Education (Singapore	Also known as: Liang Rongping		
Singapore Symphony Orchestra	Nationality: Singaporean	雄心 = Aspiration	Information About
<ul> <li>Institute of Education (Singapore)</li> <li>National Arts Council (Singapore)</li> </ul>	Awards: COMPASS Lifetime Achievement Award (2007) , Cultural Medallion (1982) , Public Service Star (2005)	W琴伴奏: 苏恒.	钢琴:苏恒&刘奕恒
National Theatre Trust (Singapore)	Alumni: Teachers' Training College (Singapore) ,		Album 喜天的歌:歌声的海洋
Metro Philharmonic society	Guildhall School of Music and Drama (London,		Performer(s) Metro Philharmonic Choir
Liang, Rongping	England) , University of Newcastle-upon-T iation: Institute of Need Help? ×	Previous 1 Nextures X	Composer(s)
	Hetro Philharmonic Society , Rediffusion Yout	Veed Help? X	Conductor(s) Liang_Rongping
			Lyricist(s)
			Arranger(s)
			Instrument(s) Voice
			Original Publisher(s) Metro Philharmonic Society

### **RANKING ALGORITHM**

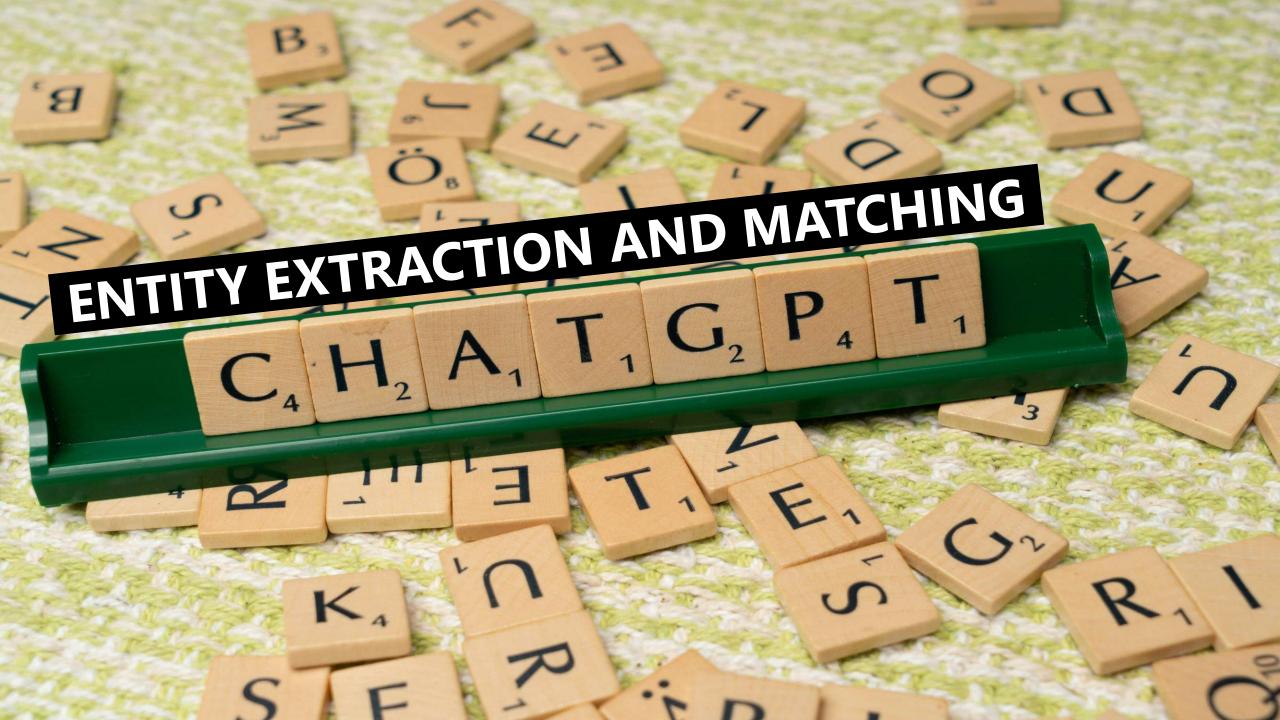
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Farquhar, William, 1774-18	Farquhar, William, 1774-1839 - <a href="https://eresources.nlb.gov.sg/linkeddata/primary-entity/person/9e94e9df-d5e4-42a4-a6de-6b327cc702a5">https://eresources.nlb.gov.sg/linkeddata/primary-entity/person/9e94e9df-d5e4-42a4-a6de-6b327cc702a5</a>		
Gibson-Hill, C. A. (Carl Alexander), 1911-1963 - <a href="https://eresources.nlb.gov.sg/linkeddata/primary-entity/person/613ef896-dcca-4186-9423-11a771696868">https://eresources.nlb.gov.sg/linkeddata/primary-entity/person/613ef896-dcca-4186-9423-11a771696868</a>			
Abdullah, Munshi, 1796-1854 - <https: 9516644c-5af8-41f9-afd2-e921a64aa818="" eresources.nlb.gov.sg="" linkeddata="" person="" primary-entity=""></https:>			
Abdul Rahman, Temenggong - <https: 5e5c5303-23bb-4b3b-a365-0e3a92e1ba2e="" eresources.nlb.gov.sg="" linkeddata="" person="" primary-entity=""></https:>			
Chow, Ah Chey - <https: bf6d1235-3e5a-4099-8ed8-6d8d64d5c0f2="" eresources.nlb.gov.sg="" linkeddata="" person="" primary-entity=""></https:>			
Kallang Basin - <https: 2986a864-595c-44de-872d-18151d374363="" eresources.nlb.gov.sg="" linkeddata="" place="" primary-entity=""></https:>			
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Bencoolen - <https: aec4007d-8245-4184-a73f-1fb7bef0cc9e="" eresources.nlb.gov.sg="" linkeddata="" place="" primary-entity=""></https:>			

Parliament House (Singapore) - <https://eresources.nlb.gov.sg/linkeddata/primary-entity/place/68c8e4dc-bcdc-4e39-8fce-0558a1a8cb84>

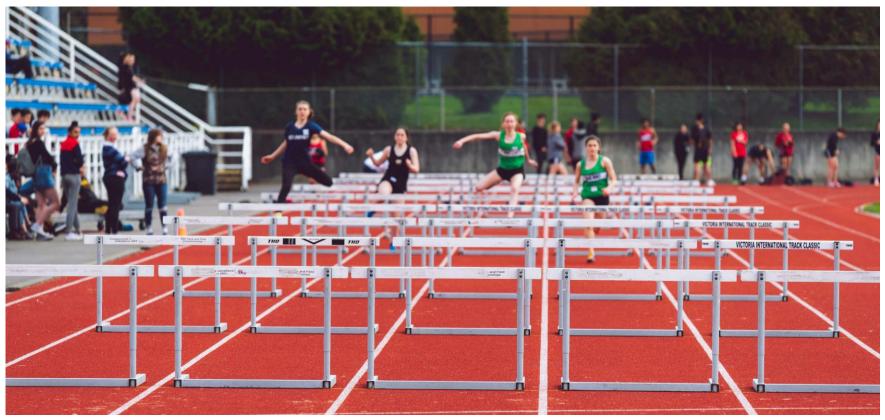
### **Relational Type Score**

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### **IMPLEMENTATION CHALLENGES**



- Over Reliance on Fixed Scores
- Limited Contextual Adaption
- Complexity in Balancing Scores



### **FUTURE PLANS**

### **USER FEEDBACK** INTEGRATION

### **SEMANTIC ANALYSIS ENHANCEMENT**

### DYNAMIC SCORING ADJUSTMENTS







### CONCLUSION



- Semantic web technologies and AI help evolve library services in the digital age, enhance resource discovery and create interconnected knowledge networks
- Traditional knowledge institutions can adapt to meet evolving user needs in a digital world

## **PUBLIC DATA ACCESS**

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	Death date:	(edtf) 1826-07-05	<pre>{</pre>		
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data.gov.sg		Try keywor	ds like: 'school' or 'weather'		Feedback Login
	Education			Singapore's open data portal	
	<b>NLB Name Authorities Attributes</b> Data from Feb 2019 to May 2023 • Updated 6 months ago			Explore national datasets and access APIs for development. Try keywords like: "HDB*, "CPF*, "Houses"	
	NLB (National Librar	<u>y Board)</u>		🕐 Arts & Culture 🔛 Education 🚔 Economy 🅟 Environment 🔍 Geospatial	
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	18657789	7 Adam Park	_GeoBuildings	A colonial bungalow located off Adam Road that was marked as a historic site	) by th





### **AUTHORITY RECORD OF SIR THOMAS STAMFORD RAFFLES**

Add Terms Raffles, Thomas Stamford, Sir ( People)

#### Raffles, Thomas Stamford, Sir

Save	Refresh	Сору
Flags	History	Subsume
Deactivate	Delete	Restore

#### Term Metadata:

Descriptor:	Raffles, Thomas Stamford, Sir		
Vocab:	_People		
Flags:	Expose, Image_links_amend, KPanelOct16, LDMS, MARC_test, Notable, Sep16Profile, VIAF_FY20, Wikidata		
Status:	Active; Approved; Preferred; Unlocked		
UID:	18338326		
Created:	factiva09 07/05/2008 3:06:36 PM		
Modified:	chow_yaw_huah 26/04/2024 8:48:19 AM		
Attribute	s:		
Name :		Raffles, Thomas Stamford	
Qualifier:			
Title:		Sir	

 
 Name (DisplayName):
 Sir Thomas Stamford Raffles

 Name (LCNA):
 Raffles, Thomas Stamford, Sir, 1781-1826

 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

#### Relationships Flat View **Hierarchy View** Add/Edit Visualize 7 Language: English Type: Radial Map ~ $\sim$ Display Options Node Style: Boxes Dots Display Multiple Pathways Crawfurd, John Abdullah Stamford Raffles Raffles, Sophia, Lady Thomas Stamford Raffles Sir Thomas Stamford Raf. Johnston, Alexander Lau. Raffles, Thomas Stamford, Si Raffles, Thomas Stamfor. Farguhar, William Colonial administrators ராஃபில்ஸ், தாமஸ் ஸ்டாம் 莱佛士,托马斯斯坦福 F..... Raffles, Olivia Mariamne CTION AND MATCHIN