

## Chinese Singaporean Temples: Digital Humanities Approaches to Frequency Lists of Sponsors

Xu Duoduo<sup>1,\*</sup>, Kenneth Dean<sup>2</sup>, Marcus Bingenheimer<sup>3</sup>, Francis Bond<sup>4</sup>

### Abstract

Epigraphy in Chinese Singaporean Temples preserves local documentation of social connections in pre-modern Singapore. However, this valuable historical source has not yet been comprehensively analysed, in part due to the large amount of documents to be catalogued. The present study aims at the development of a frequency analysis of sponsors appearing in epigraphic texts in the pre-modern Chinese Singaporean Temples. This research examines the influence of donors by assessing their frequency, highlights the connections among sponsors, and their active areas, i.e., the links of sponsors to specific temples. The study applies a digital humanities approach, by utilizing TEI, Python, DocuSky, and Palladio. TEI (Text Encoding Initiative) is used to mark up the texts of “Chinese Epigraphy in Singapore, 1819–1911.” The information under various labels can be extracted by Python programming. DocuSky is applied to produce graphic presentations that analyze the frequency of sponsors, assessing terms elicited from TEI files and terms from other sources as well. Palladio and Gephi provide graphic presentations of network among sponsors through the temples. This digital humanities work allows us to map specific aspects of Singapore in history.

**Keywords:** Chinese Temple, Frequency Analysis of Sponsors, Digital Humanities, TEI, Python, DocuSky, Palladio, Gephi

---

Manuscript received: November 25, 2019; Accepted: March 16, 2020

<sup>1</sup> Postdoctoral Fellow, Nanyang Technological University, Singapore.

<sup>2</sup> PI; Professor, Department of Chinese Studies, National University of Singapore, Singapore.

<sup>3</sup> TEI Data Structure Designer; Associate Professor, Department of Religion, Temple University, USA.

<sup>4</sup> Python Expert; Associate Professor, Linguistics and Multilingual Studies, Nanyang Technological University, Singapore

\* Email: duoduo.xu@ntu.edu.sg

## 1. Introduction

Chinese migrations have occurred in Southeast Asian since the remote times. Chinese coins dating back to 600 BC have been discovered at the mouth of the Sarawak (Hughes-Hallett, 1940, p. 24). While written records of commercial interactions between the Malay Peninsula and China could be dated back to the Han Dynasty (206BC–220AD, Jao, 1994, p. 181). The diplomatic connections between China and the Melaka Strait had prosperous development in Ming Dynasty (1368–1644), marked by the seven maritime expeditions by China's treasure fleet between 1405 and 1433.

During the British colonial era, hundreds of thousands Chinese immigrants arrived in Singapore: the number started from 30 in 1819 and reached 164,181 in 1901 (Song, 1967, pp. 22-23). The Chinese immigrants, mainly bankrupted peasants, worked as miners, workers in factories, porters, gardeners in plantations, assistants in shops, etc. Some of them started their own business with their savings later on (Lin & Zhang, 2008, pp. 243-244).

Secret societies emerged in this social context. As Mak (1981) pointed out, a brotherhood and secret society would be the logical preference ruling the heterogeneous immigrant community due to three factors: (1) the inadequacy of legal protection of Chinese settlers in a multi-ethnic society; (2) the adaptability of secret societies to changing conditions; and (3) the strength of the societies in supplying conflict-reduction mechanisms. On the other side, the establishment of temples contributed to the crystallisation of the Chinese social structure based on *bangs* 幫 (socio-economic and political groups of Chinese migrants based principally on dialect, cf. Cheng, 1985, pp. 23-34). The location of the temple indicates the initial spatial concentration of a dialect group (Cheng, 2019, p. 497).<sup>1</sup>

The epigraphs under discussion in the present study are preserved in the Chinese temples built between 1819 and 1911. Inscriptions on stones and many other mediums were considered a long-lasting method to record significant events in history and to make official important documents. In history, different types of documents have been inscribed for memory, from significant documentations, like the Code of Hammurabi for laws, the Rosetta Stone for decrees, the Stone Classics in Three Different Scripts (“三體石經” in Chinese)

---

1 According to Cheng (2019, p. 497), the concentration of Zhang-Quan 漳泉 people is in Telok Ayer 直落亞逸 Street–Amoy 廈門 Street, Chaozhou 潮州 people in Carpenter 嘉賓達 Street–Tew Chew 潮州 Street, the Hainanese in Middle 密駝 Road–Beach 美芝 Road, the Hakkas 客家 in Pekin 北京 Street, and the Cantonese 廣東 in Chinatown 牛車水.

for authentic version of ancient Chinese Classics, to folklore life records, such as plaque at the door, agreement, or epitaph.

Epigraph in Chinese Singaporean Temples is a valuable resource for the study of the pre-modern history of Singapore. Besides the records of the former colonial administrators (e.g., Raffles, 1830), navigation logs (e.g., Goncharov, 1879/1987), and ancient Chinese literature about Singapore (cf. Jao, 1994), epigraphic texts are local sources documenting the history of this land.

Epigraphs on stelae, plaques, couplets, and other items, commemorate an event, as well as the people participated in that event. A typical stele epigraph is composed of a title, a preface stating the event, a panel displaying the major organizers, a long list of sponsors (usually referred as “Fangminglu 芳名錄”), and a dateline together with the corresponding persons erecting the stele. There are also other forms of epigraphic texts, e.g., plaques and couplets. In these kinds of epigraphs, the main texts are compliments dedicated to the worshipped gods, while a dateline and donors are also included. These literal records depict the social network and interactions among community leaders, civilians, and organizations. The act of inscribing texts into stelae can be considered a way of common people to build up memory, or history, by themselves. From these epigraphic recordings it is possible to highlight the activities of donors in their lives. Furthermore, eliciting clues from these inscriptions can contribute in building up a biographic history of Singapore.

So far, scholars have compiled several collections of Chinese Epigraphy in Singapore, e.g., Chen & Chen (1970), Lim et al. (1975), and Chng (1984). Among these catalogues, Dean & Hue (2017) is a recent edition with new field work data and bilingual interpretations. Besides the systematically organized epigraphic texts, a digital version of the book, which can be connected with related databases (e.g., Singapore Biography Database, SBDB [<http://sbdb.nus.edu.sg/>]), is in preparation.<sup>2</sup> TEI (Text Encoding Initiative) standard is used to mark up the texts of “Chinese Epigraphy in Singapore, 1819–1911”. Based on this new version of the text, the information under various labels can be extracted by Python programming. Further on, Docusky is applied to produce frequency analysis of sponsors, assessing terms elicited from marked xml files

---

2 The sources of the Singapore Biographical Database (SBDB) include Kua (1995), Dean & Hue (2017), Song (1984), Lin et al. (1922–1941), which include historical documentation and first-hand fieldwork material. Besides prominent figures in the history of Singapore, it lists significant people in Malaya as well. SBDB also displays preliminary analysis of social network of selected families. It divides 200 years (1819–2019) into eight generations in order to analyze the network in different periods in history.

and terms from other sources as well. While Palladio and Gephi provide graphic presentations of network among sponsors through the temples.

## 2. Preparation of the Database

### 2.1 TEI Mark-Up

The book “Chinese Epigraphy in Singapore, 1819–1911” (NUS Press, 2 volumes, 1422 pages) consists of preface, body part (63 chapters), and appendix. Each chapter documents one Chinese Temple in Singapore. These chapters share a similar structure. Therefore, one template can be highlighted to be filled in with various contents. The current template was initially set up by Marcus Bingenheimer, and modified by the author during the mark-up of each chapter and appendix.

According to these epigraphic records, the sponsors can be individual persons, associations, stores, ships (or boats),<sup>3</sup> factories, etc. Sometimes, they are specific groups of people, like a group of people from the same place in China, or a group of people with shared social roles (e.g., businessmen, Buddhism believers). TEI encoding standard contains a set of terms used to mark sorted names. For example, “<persName>” is used to mark person’s name, “<orgName>” is used to mark organization’s name, “<placeName>” is used to mark place’s name. It is also possible to distinguish the internal components of each name. For example, “<surname>” marks the family name, “<forename>” marks given name, “<roleName>” indicates a particular role or position in society. In this framework, researchers can annotate biographic information of the person as well.<sup>4</sup>

In the current project, individual persons are labelled as “<persName>”; social roles connected to personal names are labelled by “<roleName>”; groups of people without specific designations are marked under the label “<orgName>”; organizations, such as associations, banks, gold stores, jewellers, pharmacies, tobacco companies, restaurants, ships (or boats), stores, factories, etc., are referred by the label “<orgName>”. These organizations can

3 Ships and boats were commercial units like stores and factories in maritime Singapore (cf. Cameron, 1865, pp. 56-58).

4 For more comprehensive information, please, refer to “P5 Guidelines” which is available on the official website of TEI ([tei-c.org/guidelines/p5/](http://tei-c.org/guidelines/p5/)).



be furtherly distinguished by adding specific types of organizations. Here are examples representing various cases:

- (1) “Mr. Lim Hng Kiang ( 林勛強先生 )” (No. 1.37)<sup>5</sup>:  
`<persName> 林勛強 <roleName> 先生 </roleName></persName>`;
- (2) “Elite merchants from Canton ( 粵東衆紳商 )” (No. 1.14)<sup>6</sup>:  
`<orgName type="group"> 粵東衆紳商 </roleName>`;
- (3) “Penang Teochew Association ( 檳榔嶼潮州會館 )” (No. 1.32):  
`<orgName type="association"> 檳榔嶼潮州會館 </orgName>`;
- (4) “Lee Hwa Bank ( 利華銀行 )” (No. 1.49):  
`<orgName type="bank"> 利華銀行 </orgName>`;
- (5) “Leung Kai Fook Pharmacy ( 梁介福藥行 )” (No. 1.49):  
`<orgName type="pharmacy"> 梁介福藥行 </orgName>`.

## 2.2 Python Programming

The marked-up text classifies the information through sorted labels and can be further on processed by programming for data mining. The programming language chosen for this study is Python. The present module is designed to print out the label of epigraph the names of the sponsors (persons and organizations), their places of origins, the quantities, and the dates. Figure 1 below is an example of running this Python module over the xml files with TEI encoding. These records are the names of the donors recorded by the epigraphy located in Hok Tek Chi Loke Yah Teng Association ( 福德祠綠野亭工會 “Fude Ci Lüye Ting Gonghui”), cf. Chapter 7 of Dean & Hue (2017, p. 181).

In the context of Python language, texts are “strings,” while labels added to the texts are “attributes” that annotate the features of the texts. Like other programming languages, Python program reads the texts in a linear way. In other words, it cannot read strings “interrupted” by labels. For example, if a marked up string is `<persName><roleName> 福章妻 </roleName> 柯氏 </persName>` (“Fuzhang’s wife Ms Ke”, No. 60.01), only the text marked as `<roleName>`, i.e.,

5 The numbers in bracket indicate the location of the epigraphy. Take the one *ad hoc*, for instance, “No. 1.32” refers to the 32nd item in Chapter 1.

6 The term “Shenshang 紳商” is explained in Dean & Hue (2017, p. 34).

A	B	C	D	E	F	G	H	I	J	K
Label	Epigraph	placeName	roleName	persName	orgName	quantity	quantity_value	size(cm)	Date	Date-iso
1	7.01	廣東省永定縣重修塚山碑記	番邑	胡南生		三十五元	35	158 x 76	道光庚子歲升年仲秋 吉旦	1840
2	7.01	廣東省永定縣重修塚山碑記			新南利莊和興公司	二十元	20	158 x 76	道光庚子歲升年仲秋 吉旦	1840
3	7.01	廣東省永定縣重修塚山碑記	順邑	何阿旦		二十元	20	158 x 76	道光庚子歲升年仲秋 吉旦	1840
4	7.01	廣東省永定縣重修塚山碑記	嘉應	劉恒興		二十元	20	158 x 76	道光庚子歲升年仲秋 吉旦	1840
5	7.01	廣東省永定縣重修塚山碑記	善邑	黃亞周		十五元	15	158 x 76	道光庚子歲升年仲秋 吉旦	1840
6	7.01	廣東省永定縣重修塚山碑記	寧邑	梁享才		十五元	15	158 x 76	道光庚子歲升年仲秋 吉旦	1840
7	7.01	廣東省永定縣重修塚山碑記			達泰莊公司	十五元	15	158 x 76	道光庚子歲升年仲秋 吉旦	1840
8	7.01	廣東省永定縣重修塚山碑記			梁就利公司	十二元	12	158 x 76	道光庚子歲升年仲秋 吉旦	1840
9	7.01	廣東省永定縣重修塚山碑記			順發莊公司	十一元	11	158 x 76	道光庚子歲升年仲秋 吉旦	1840
10	7.01	廣東省永定縣重修塚山碑記	莞邑	鄧亞進				158 x 76	道光庚子歲升年仲秋 吉旦	1840
11	7.01	廣東省永定縣重修塚山碑記			李福安莊			158 x 76	道光庚子歲升年仲秋 吉旦	1840
12	7.01	廣東省永定縣重修塚山碑記			金昌利莊			158 x 76	道光庚子歲升年仲秋 吉旦	1840
13	7.01	廣東省永定縣重修塚山碑記			萬利莊			158 x 76	道光庚子歲升年仲秋 吉旦	1840
14	7.01	廣東省永定縣重修塚山碑記		宋亞旺				158 x 76	道光庚子歲升年仲秋 吉旦	1840
15	7.01	廣東省永定縣重修塚山碑記	順邑	林亞培				158 x 76	道光庚子歲升年仲秋 吉旦	1840
16	7.01	廣東省永定縣重修塚山碑記	會邑	楊朝象				158 x 76	道光庚子歲升年仲秋 吉旦	1840
17	7.01	廣東省永定縣重修塚山碑記	清邑	李金贊				158 x 76	道光庚子歲升年仲秋 吉旦	1840
18	7.01	廣東省永定縣重修塚山碑記	嘉應	劉錫清				158 x 76	道光庚子歲升年仲秋 吉旦	1840
19	7.01	廣東省永定縣重修塚山碑記	大埔	陳壽雲				158 x 76	道光庚子歲升年仲秋 吉旦	1840
20	7.01	廣東省永定縣重修塚山碑記		朱振合				158 x 76	道光庚子歲升年仲秋 吉旦	1840
21	7.01	廣東省永定縣重修塚山碑記	豐順	張元谷				158 x 76	道光庚子歲升年仲秋 吉旦	1840
22	7.01	廣東省永定縣重修塚山碑記	順邑	饒亞奕				158 x 76	道光庚子歲升年仲秋 吉旦	1840
23	7.01	廣東省永定縣重修塚山碑記				十元	10	158 x 76	道光庚子歲升年仲秋 吉旦	1840
24	7.01	廣東省永定縣重修塚山碑記	豐順		郭合利莊			158 x 76	道光庚子歲升年仲秋 吉旦	1840
25	7.01	廣東省永定縣重修塚山碑記			廣萬興莊			158 x 76	道光庚子歲升年仲秋 吉旦	1840
26	7.01	廣東省永定縣重修塚山碑記			月利莊			158 x 76	道光庚子歲升年仲秋 吉旦	1840
27	7.01	廣東省永定縣重修塚山碑記			義合莊			158 x 76	道光庚子歲升年仲秋 吉旦	1840
28	7.01	廣東省永定縣重修塚山碑記	順邑	陳亞寧				158 x 76	道光庚子歲升年仲秋 吉旦	1840
29	7.01	廣東省永定縣重修塚山碑記				八元	8	158 x 76	道光庚子歲升年仲秋 吉旦	1840

Figure 1. Sample of Output of the Python Program

Source: This study.

“福章妻” can be found by the program.<sup>7</sup> Therefore, even if the role-name is necessary for identifying the person’s name, the author marked it in a “lineal” way as <roleName>福章妻 </roleName><persName>柯氏 </persName>, which is also within the flexibility of TEI standard. On the other hand, if a marked-up string is <persName>德勝 <placeName>(丹麥) <placeName></persName> (No. 60.05), both <persName> and <placeName> can be found by the program.

Moreover, many epigraphic texts are composed in a concise way, and repetitive details are omitted. For example, for the donors contributing the same amount, the donation is inscribed only once before or after the list of all their names. In this case, when Python program prints the results into a spreadsheet, the text about donation appears only once. An alternative solution would be completing each entry by filling the amount of donation after the sponsor’s name. If the original text in this format: <item><persName></persName></item>, the expanded version would be in this format: <item><persName></persName><supplied><measure quantity="" unit=""></supplied></item>.<sup>8</sup> The label <supplied> indicates that the information is added by the coder. Since

7 Gloss of “福章妻柯氏” (“Fuzhang Qi Keshi”): “Fuzhang” is the name of a man, “Qi” means “wife”, “Ke” is the surname of his wife, and “shi” is a morpheme attached to a surname in order to refer to a woman from a certain family.

8 The long name lists of donors, referred to as “Fangminglu 芳名錄”, are marked up as “lists” in TEI files. Inside a list (<list>), each entry of donation is marked as an “item” (<item>).

there are tens of thousands of entries about donations, the “completion” of original texts is not convenient and complicates the TEI files at the same time. Therefore, in the current Project, the author chose to edit the results printed into an excel spreadsheet by the program. Figure 2 is the spreadsheet displaying related information of donors after slight manual edition, in comparison to Figure 1.

The combination of xml and programming allows the researchers to get exhaustive results from big amounts of data in an automatic way. The module can also be modified to elicit other types of information with labels in the xml files. A brief calculation according to the spreadsheet generated by this Python program shows that around 58,600 records of donations (or other ways of contributions) have been attested among the epigraphic texts, in which around 48,000 entries are from individuals and around 10,200 from organizations (or group donations).<sup>9</sup>

### 3. Frequency Analysis of Sponsors

In the SBDB Project, supervised by Kenneth Dean, 784 Chinese people with significant roles in the history of pre-modern Singapore have been chosen

	A	B	C	D	E	F	G	H	I	J	K
1	Label	Epigraph	placeName	roleName	persName	orgName	quantity	quantity_value	size(cm)	Date	Date-iso
2	7.01	廣東省永定縣重修塚山碑記	番邑		胡南生		三十五元	35	158 x 76	道光庚子歲升年仲秋 吉旦	1840
3	7.01	廣東省永定縣重修塚山碑記				新商利莊	二十元	20	158 x 76	道光庚子歲升年仲秋 吉旦	1840
4	7.01	廣東省永定縣重修塚山碑記	順邑		何阿目		二十元	20	158 x 76	道光庚子歲升年仲秋 吉旦	1840
5	7.01	廣東省永定縣重修塚山碑記	嘉應		劉恆興		二十元	20	158 x 76	道光庚子歲升年仲秋 吉旦	1840
6	7.01	廣東省永定縣重修塚山碑記	番邑		黃亞周		十五元	15	158 x 76	道光庚子歲升年仲秋 吉旦	1840
7	7.01	廣東省永定縣重修塚山碑記	寮邑		梁享才		十五元	15	158 x 76	道光庚子歲升年仲秋 吉旦	1840
8	7.01	廣東省永定縣重修塚山碑記				達泰莊公	十五元	15	158 x 76	道光庚子歲升年仲秋 吉旦	1840
9	7.01	廣東省永定縣重修塚山碑記				梁就利公	十二元	12	158 x 76	道光庚子歲升年仲秋 吉旦	1840
10	7.01	廣東省永定縣重修塚山碑記				順發莊公	十一元	11	158 x 76	道光庚子歲升年仲秋 吉旦	1840
11	7.01	廣東省永定縣重修塚山碑記	苑邑		鄧亞進		十元	10	158 x 76	道光庚子歲升年仲秋 吉旦	1840
12	7.01	廣東省永定縣重修塚山碑記				李福安莊	十元	10	158 x 76	道光庚子歲升年仲秋 吉旦	1840
13	7.01	廣東省永定縣重修塚山碑記				金昌利莊	十元	10	158 x 76	道光庚子歲升年仲秋 吉旦	1840
14	7.01	廣東省永定縣重修塚山碑記				萬利莊	十元	10	158 x 76	道光庚子歲升年仲秋 吉旦	1840
15	7.01	廣東省永定縣重修塚山碑記			宋亞旺		十元	10	158 x 76	道光庚子歲升年仲秋 吉旦	1840
16	7.01	廣東省永定縣重修塚山碑記	順邑		林亞培		十元	10	158 x 76	道光庚子歲升年仲秋 吉旦	1840
17	7.01	廣東省永定縣重修塚山碑記	會邑		楊朝象		十元	10	158 x 76	道光庚子歲升年仲秋 吉旦	1840
18	7.01	廣東省永定縣重修塚山碑記	清邑		李金寶		十元	10	158 x 76	道光庚子歲升年仲秋 吉旦	1840
19	7.01	廣東省永定縣重修塚山碑記	嘉應		劉露清		十元	10	158 x 76	道光庚子歲升年仲秋 吉旦	1840
20	7.01	廣東省永定縣重修塚山碑記	大埔		陳嘉雲		十元	10	158 x 76	道光庚子歲升年仲秋 吉旦	1840
21	7.01	廣東省永定縣重修塚山碑記			朱振合		十元	10	158 x 76	道光庚子歲升年仲秋 吉旦	1840
22	7.01	廣東省永定縣重修塚山碑記	豐順		張元谷		十元	10	158 x 76	道光庚子歲升年仲秋 吉旦	1840
23	7.01	廣東省永定縣重修塚山碑記	順邑		饒亞奕		十元	10	158 x 76	道光庚子歲升年仲秋 吉旦	1840
24	7.01	廣東省永定縣重修塚山碑記	豐順		郭合利莊		八元	8	158 x 76	道光庚子歲升年仲秋 吉旦	1840

Figure 2. The Output of Python Programming After Slight Amendment

Source: This study.

9 The Python script has been written with the help of Francis Bond, and has been presented at the 2019 Pacific Neighborhood Consortium Annual Conference and Joint Meetings (PNC), cf. Xu, Bond, & Dean (2019).

at the current stage as the bases to build up a biographic network.<sup>10</sup> These 784 figures are elicited from a converging database of several biographical recourses, like Lin et al. (1922–1941), which compiled short biographies of 3,045 Chinese people active in commercial activities in Southeast Asia, and Kua (1995), in which 1,175 Singaporean Chinese people living between 1819 and 1990 are documented. At the moment, there are 4064 people in this general database. The author examined the frequency of both SBDB and the entire dataset among the pre-modern epigraphic texts. If the person names from these databases can be attested among the epigraphic texts, these inscribed records would provide original documentations of their social activities.

The tool chosen to examine the “overlap” between SBDB and Epigraphy is DocuSky.<sup>11</sup> The panel “Exploration and Analysis 探勘與分析” in this platform is designed for analysing the frequency of terms in texts. For the present study, the author prepared 64 text files (one per each chapter and one appendix) for term frequency analysis.<sup>12</sup> According to the analysis run by DocuSky, among the 784 nodes of SBDB, 204 are attested in the Chinese Epigraphy of Singapore between 1819 and 1911. Figure 3 includes the first 20 figures with more recordings in Dean & Hue (2017). In Figure 3, “TF” stands for the frequency of a specific term among all the documents, while “DF” stands for the frequency of the document that contains the term. For example, as shown in Figure 3a, the person with the third most entries is Low Kim Pong 劉金榜, who appeared 31 times in the whole text and in 5 different files, i.e., five different temples or organizations. Some other examples: the fifth, Chong Mong Sang 張夢生, attested 15 times in 4 files; the sixth Tan Tock Seng 陳篤生, 14 entries in 2 files; the thirteenth Cheang Hong Lim 章芳琳, attested 6 times in 2 files.

In the more comprehensive biography database with 4,046 figures, 536 are attested in these Chinese epigraphic texts. Figure 3b displays the twenty most mentioned people. Besides some shared high frequency names, like Low

10 The data is downloadable from the webpage of SBDB: [sdbd.nus.edu.sg](http://sdbd.nus.edu.sg).

11 DocuSky is an open source online platform developed by the National Taiwan University ([docusky.org.tw/DocuSky/ds-01.home.html](http://docusky.org.tw/DocuSky/ds-01.home.html)). This platform provides various types of software for data mining. Michael Stanley-Baker has kindly introduced DocuSky, MARKUS, and Palladio to the author for digital humanities research.

12 The TEI files are in xml format and with metadata added to the original texts of the book. In order to transform them into plain texts, MARKUS has been involved as a transitional platform. MARKUS is an online annotation and text analysis program developed by Brent Ho and Hilde De Weerd with funding from the European Research Council and Digging into Data (<https://dh.chinese-empires.eu/markus/>). The author uploaded the TEI files to MARKUS platform, selecting “Manual markup”, and the plain texts with labels removed can be collected.

1	Category	Term	TF	DF
2	SBDB nam	陳振	44	18
3	SBDB nam	吳氏	36	13
4	SBDB nam	劉金榜	31	5
5	SBDB nam	陳篤	19	5
6	SBDB nam	張夢生	15	4
7	SBDB nam	陳篤生	14	2
8	SBDB nam	陳泰	13	8
9	SBDB nam	潘受	12	3
10	SBDB nam	林漢	11	9
11	SBDB nam	梅端成	8	6
12	SBDB nam	黃樹芬	8	4
13	SBDB nam	郭新	6	4
14	SBDB nam	章芳琳	6	2
15	SBDB nam	薛佛記	6	2
16	SBDB nam	許行雲	6	4
17	SBDB nam	吳勝鵬	6	3
18	SBDB nam	陸寅傑	6	4
19	SBDB nam	王長順	6	2
20	SBDB nam	陳有郎	5	4
21	SBDB nam	陳金殿	5	5

(a)

1	Category	Term	TF	DF
2	Liezhuan	劉金榜	31	5
3	Liezhuan	林明	23	10
4	Liezhuan	陳景	21	7
5	Liezhuan	梁元浩	18	3
6	Liezhuan	張夢生	15	4
7	Liezhuan	陳篤生	14	2
8	Liezhuan	陳泰	13	8
9	Liezhuan	陳添	13	8
10	Liezhuan	黃昌	12	5
11	Liezhuan	藍如晏	11	4
12	Liezhuan	林漢	11	9
13	Liezhuan	黃衍華	11	2
14	Liezhuan	何啟榮	10	3
15	Liezhuan	黃載靈	10	2
16	Liezhuan	馬純清	10	2
17	Liezhuan	陳清吉	9	5
18	Liezhuan	李成	9	7
19	Liezhuan	藍建海	8	3
20	Liezhuan	黃榮	8	8
21	Liezhuan	黃樹芬	8	4

(b)

Figure 3. Samples of Frequency Analysis by DocuSky

Source: This study.

Kim Pong 劉金榜, Chong Mong Sang 張夢生, Tan Tock Seng 陳篤生, Wong Shee Fun 黃樹芬, there are some additional names with high frequency listed in Figure 4b if compared to Figure 4a. For example, Leong Yun Hou 梁元浩, Lam Joo Onn 藍如晏, Wong Yin Wah 黃衍華, Ho Khee Yong 何啟榮, Wang Jai Ling 黃載靈, Ma Chun Qing 馬純清, Tan Cheng Kiat 陳清吉, and Lam Kian Hoi 藍建海. It is also possible to notice that the first two names in Figure 4a are not in Figure 4b, while the figures in SBDB were supposed to have been selected from the general database of historical figures. This is because some names from Chinese Epigraphy considered significant, while not documented in the biography resources, have been added to the SBDB name list. This panel in DocuSky also produces a word cloud image according to the statistics of its analysis, showing the frequency of terms by different font sizes: the more a term is attested, the bigger font size is assigned to that term (as seen in Figure 4).

The results of frequency analysis at this stage, generated through DocuSky,



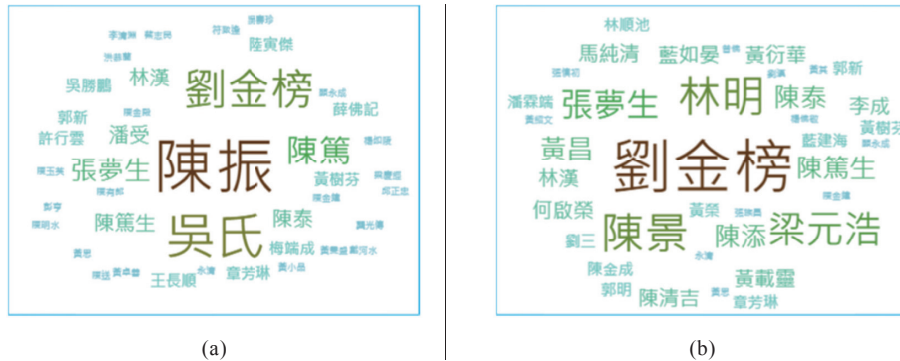


Figure 4. Word Cloud Images by DocuSky

Source: This study.

show a preliminary calculation of the frequency of terms. In order to get more precise calculation of name frequency in epigraphic texts, the author briefly removed the sections mainly written by the book authors from the original texts of the book, where the sponsors could be mentioned repetitively. The removed sections include introduction, list of Artefacts, and endnotes of the chapter. However, there are still some repetitions due to the arrangement of the texts, like descriptions and subtitles edited by the authors. Therefore, in order to get more precise data of frequency of the terms, the text for analysis still needs to be examined, keeping only the transcriptions of the inscriptions in stelae, plaques, couplets, etc.

Moreover, some names can refer to more than one specific person. For example, the first name in the list is “陳振”. Checking through the text of the book, it is possible to find out that, instead of one donor named “陳振,” the 44 entries are connected with 32 different names including the two characters “陳振,” while nobody in the epigraphic texts was really named “陳振.”<sup>13</sup> For another instance, the second name in the list, “吳氏,” is a family name. Looking into the original text, this term is used to refer to the Wu Family (e.g., Wu’s Clan Literary Association of Canton 廣東吳氏書室; Wu’s Clan Association of Hainan 瓊州吳氏公會), and a lady whose surname is Wu as well. The entries of the fourth name in the list, “陳篤,” are overlapped with the sixth name in the list, “陳篤生.” Besides the 14 entries of “陳篤生,” the

13 The 44 entries include: 陳振記, 陳振旭, 陳振觀, 陳振元 (2), 陳振成號, 陳振興號, 陳振德 (2), 陳振觀, 陳振生 (4), 陳振合, 陳振榮 (2), 陳振華, 陳振象, 陳振享, 陳振齊, 陳振雲, 陳振君, 陳振興, 陳振祿 (2), 陳振成 (3), 陳振牙, 陳振峰, 陳振武, 陳振玉, 陳振英, 陳振泰 (2), 陳振蕊 (3), 陳振煜, 陳振雲, 陳振吉, 陳振聲, 陳振豐號.

other five entries include the characters “陳篤” are “陳篤宗” and “陳篤漢” (4). The sixth name in the list, “陳泰,” is another example of similar situation: besides the donor “陳泰,” there are many ‘three-character’ names, such as 陳泰義, 陳泰友, 陳泰階, 陳泰山, 陳泰□ (unclear character in the stela), 陳泰源 (2), 陳泰安, 陳泰理, 陳泰美 (2), 陳泰盛. In other words, among the donors other than 陳泰, all these names including the two characters “陳泰” are all counted as the frequency of the name “陳泰.” In these cases, a manual check is necessary to distinguish the figures connected with the same name.

The preliminary results from DocuSky provide a generic picture of the frequencies of the names, which represents the active level or the influences of people to some extent. In order to find out their relationship with the temples or other organizations, it is necessary to go through the epigraphic recordings.

#### 4. Graphic Presentation of Network

Palladio (<http://hdlab.stanford.edu/palladio/>) and Gephi (<https://gephi.org/>) are applied in the present study in order to provide graphic presentation of network.<sup>14</sup> Palladio is a platform designed for visualizing complex historical data, while Gephi is considered the leading visualization and exploration software for all kinds of graphs and networks. The author examines the data in both approaches for exploring the network of Chinese clans documented in pre-modern Singaporean epigraphs, and for comparing the two tools as well.

In Social Network Analysis, the basic elements include actors and relational ties (linkages) among them (Wasserman & Faust, 1994, p. 4). The “actors” are generally named “nodes” when they are in Digital Humanities and computational contexts. In the present study, the nodes composing the network can be divided into two types: organizations (temples, associations, and other institutions) and sponsors.

The name list of sponsors is elicited from the epigraphic texts by Python program mentioned in Section 2.2. The sponsors can be roughly divided into two groups: individual sponsors (marked as <persName> in TEI) and group sponsors (marked as <orgName> in TEI). After cleaning up the list of organizations elicited by Python program, by removing the unrecognizable entries (unclear characters, etc.), 9,665 group donors (out of around 10,200 entries) remained for making this visualization process.

---

<sup>14</sup> Palladio and Gephi both are open-sources.



#### 4.1 Palladio Presentation

In the image of the network produced by Palladio, the nodes for organizations are in dark grey, and the sizes are proportional according to the number of links connected with them. The nodes representing group donors are in light grey. The light grey lines show the connections between the group donors and the organizations, “sources” and “targets” in Palladio platform. The “dark clouds” are aggregations of group donors’ names.

In the Palladio image of the whole set of data of group donors, it is possible to notice some “isolated” clouds (marked by red circles). It means they are organized without group donors attested contributing to other institutions. These organizations include Wak Hai Cheng Bio 粵海清廟 (1819), Kim Lan Temple 金蘭廟 (1830), Ancient Temple of Shunxing 順興古廟 (1851), Sanyi Ancestral Temple 三邑祠 (1901), Seng Wong Beo Temple 都城隍廟 (1905), Swee Kow Kuan Temple 水溝館 (1905), Obelisk commemorating the second visit to Singapore by the Marquis of Dalhousie, Bovernor-General of India 印度總督遊新紀念碑 (1850), Fountain Commemorating Tan Kim Seng 紀念陳金聲噴水池 (1882), Statue of Queen Victoria 維多利亞女王金禧紀念碑 (1887), and Japanese collective tomb 日本人共同墓地 (1911). The remains of the inscriptions, the range of people involved in the event, as well as the designations of the group donors, all affect the social connections of the organization. For example, some of the group donors of Wak Hai Cheng Bio 粵海清廟 are named according to their places of origin, like “elite merchants from Guang Dong 粵東眾紳商” (Dean & Hue, 2017, p. 12); terms which are not used in other inscriptions.

Besides these nine “independent” organizations, there are other fifty-two temples/associations in this image. Most of them are with multiple connections among each other, i.e., they have shared group donors. Figure 6 is based on the 9412 group donors, attested in the inscriptions of those 52 organizations which have connections among each other. In Figure 6, twenty-eight nodes are noticeable at the current scale. They are highlighted by red dots and annotated with their Romanized appellations. The other twenty-six can be visible by zooming into the “clouds” overlapping with each other.

To some extent, the location of the target node indicates the active level of its group donors’ connections with other organizations: the source nodes are supposed to be at equal distance from the target node, if they have no other connected targets; the more the source nodes (group donors) are involved with other organizations, the further they pull the target node from the centre.



Association 茶陽會館 (1858), Ancient Temple of Vast Fortune 廣福古廟 (1863), and Lau Kwan Cheong Chew Ku Seng Wui Kun 劉關張趙古城會館 (1874). The fourth one is apparently a clan hall serving Singapore immigrants and descendants of four surnames: Lau, Kwan, Cheong, and Chew (Dean & Hue,

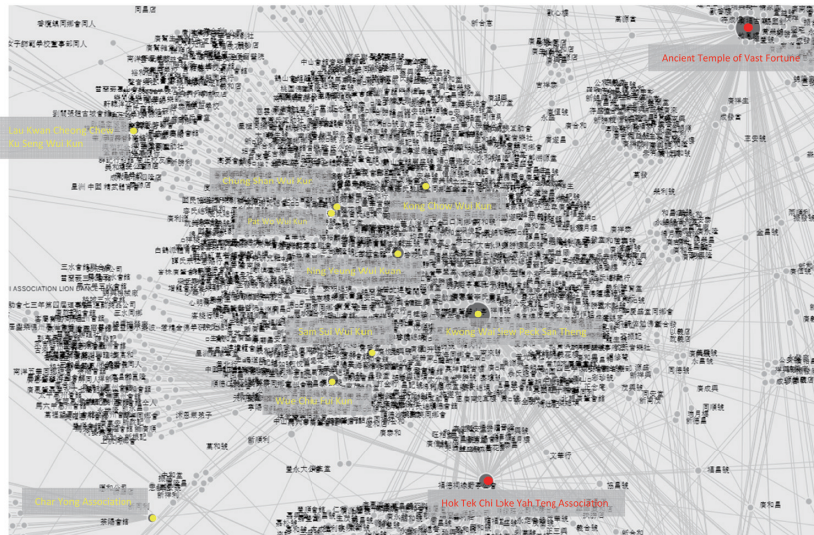


Figure 7a. Zoom-In of Up-Left Square in Fig 6.

Source: This study.

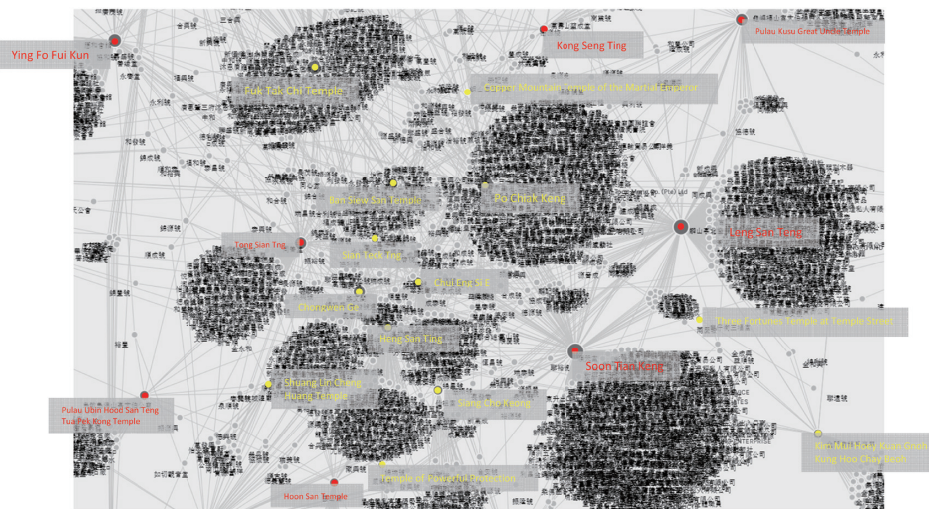


Figure 7b. Zoom-In of Low-Right Square in Fig 6.

Source: This study.



2017, p. 470). As mentioned in Mak (1985, p. 146), lineage groups generally should be an organization beyond dialect community. According to the composition of group donors, it is possible to assume that Lau Kwan Cheong Chew Ku Seng Wui Kun 劉關張趙古城會館 is basically an association of the Cantonese clan.

Figure 7b is a zoomed-in image to the low-right area (circled by dash-line square) of Figure 6. Other thirteen organizations (marked in yellow) are visible in this image, if compared to Figure 6. Three of these nodes are located inside one name cloud: Fuk Tak Chi Temple 海唇福德祠 (1824), Po Chiak Keng 保赤宮 (1878), and Ban Siew San Temple 萬壽山觀音堂 (1892). Fuk Tak Chi Temple 福德祠 is a centre of the joint Cantonese and Hakka associations, Po Chiak Keng 保赤宮 is a lineage hall serving for Chen Surname Clan, and Ban Siew San Temple 萬壽山觀音堂 is a branch hall of Xiantianjiao (Way of Prior Heaven).<sup>15</sup> The nodes representing this temple/lineage hall located inside the “clouds” mean that more group donors associate themselves with single organizations, rather than participating to activities of multiple organizations. On the other hand, the nodes of Chui Eng Si E 萃英書院 (1861), Chongwen Ge 崇文閣 (1867), Siang Cho Keong 仙祖宮 (1868), and Kim Mui Hoey Kuan Gnoh Kung Hoo Chay Beoh 金門會館孚濟廟 (1876), are in the positions as joints radiating to different “clouds”. Such pattern indicates that these organizations are founded on joint contributions from several multiple major communities. As an intermediate situation, some of the organization’s nodes are on the edge of one cloud, with links to other minor clouds, e.g., Heng San Ting 恆山亭 (1828), Shuang Lin Cheng Huang Temple 雙林城隍廟 (1902), and Temple of Powerful Protection 威震廟 (1909). This pattern indicates that the association has a majority of group donors only affiliated to it, while some of its group donors are involved also in some other associations. Sometimes, the groups donors with links to multiple associations act as a sub-community, which reflects in the network image as a minor “cloud” on the joint to different major “clouds”.

By analysing the group donors, Figure 7a and 7b roughly revealed a different pattern between Cantonese and Hokkien clans. The Cantonese associations are founded by more or less the same contributors. Conversely, the Hokkien associations are founded through contributions from various communities. This fact can be interpreted as: Cantonese associations are multiplications of the core organizers, while Hokkien associations are expansions incorporating all the Hokkien members. According to Lim (2019,

15 For more details of these three institutions, cf. Dean & Hue (2017, pp. 36, 604-605, 727).

p. 122), the formation of Teochew, Cantonese, Hakka, and Hainanese *bangs* 幫 in 19th century Singapore was a strategy to counter the over-powering Hokkien *bang*. Moreover, the Cantonese and Hakka *bangs* were the core forces, while the Teochew and Hainanese *bangs* played supportive roles. Considering this social context, the different patterns shown in Figure 7a and 7b depict the strengths of Cantonese and Hokkien clans: Hokkien had resources to organize multiple associations, while Cantonese had less resources. Therefore, in order to maintain an apparent balance, the Cantonese used repeatedly their social resources to form organizations in a relatively equivalent number as the Hokkien clans.

## 4.2 Gephi Presentation

Gephi is a more automated tool aiming at social network analysis. It is equipped with a number of statistical analyses algorithms related to notions in the field of Social Network Analysis (Wasserman & Faust, 1994, pp. 17-21). Different from Palladio, both “source” and “target” are considered “node” in Gephi, and they are distinguished by “directed edge”. The term “edge” refers to the connection between nodes.

Figure 8 is a social network image based on the salience of each node (applying OpenOrd imbedded in Gephi). Sixty-two nodes are counted as significant joints among the 6,841 nodes read by Gephi, with the input of the 9,665 entries of group donations. The 6,841 nodes are assigned to different colors, according to the number of links with other nodes (indicated as “Weighted Degree” in the colour scale). The number besides each colour displays the number of edges attached to the node. The percentage in the brackets shows the proportion of the node with the same weight.

These nodes are arranged into different layers of the image according to their weights. By applying the filter, it is possible to visualize the nodes with different weights. The node with most edges is Kheng Chiu Tin Hou Kong 瓊州天后宮 (1876), in which 1,364 different group donors are attested. The second weighted node is Kwong Wai Siew Peck San Theng 廣惠肇碧山亭 (1890), involving 1,275 different group donors. And the third is Ancient Temple of Vast Fortune 廣福古廟 (1863), related to 1,190 different group donors.

Below are four images showing the connections among organizations, filtering the nodes according to the number of edges linked to them. Figure 9a shows the nodes with more than 200 edges, Figure 9b the nodes with more

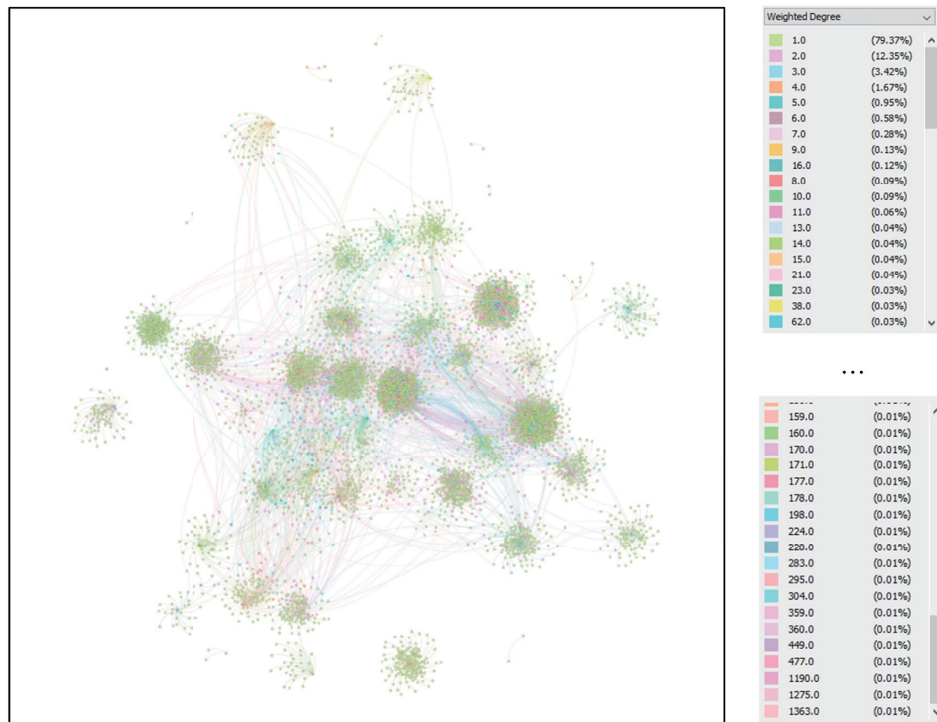


Figure 8. Social Network Image of Group Donors by Gephi

Source: This study.

than 100 edges, Figure 9c the nodes with more than 50 edges, and Figure 9d the nodes with more than 20 edges.<sup>16</sup> In these figures, the linkage among the temples/associations is depicted through different weight lines. These results are calculations by Gephi.

From Figure 9a to Figure 9d, the images show the expansion of the network from major connections among organizations to the minor ones. In Figure 9a, examining the network among organizations involving contributions from more than 200 group donors, there are only two lines among three organizations: Ying Fo Fui Kun 應和會館 (1841) and Kwong Wai Siew Peck San Theng 廣惠肇碧山亭 (1890) with Hok Tek Chi Loke Yah Teng Association 福德祠綠野亭公會 (1840), respectively. In Figure 9b, two lines between Ning Yeung Wui Kuan 寧陽會館 (1848) and Kwong Wai Siew Peck San Theng 廣惠肇碧山亭 (1890) are added. The two lines can be interpreted as two sub-communities of group donors, whose scale is between 100 and 200. There is also a link between Hong San See

<sup>16</sup> The background colours are chosen accordingly in order to have a clearer visualization of the image.

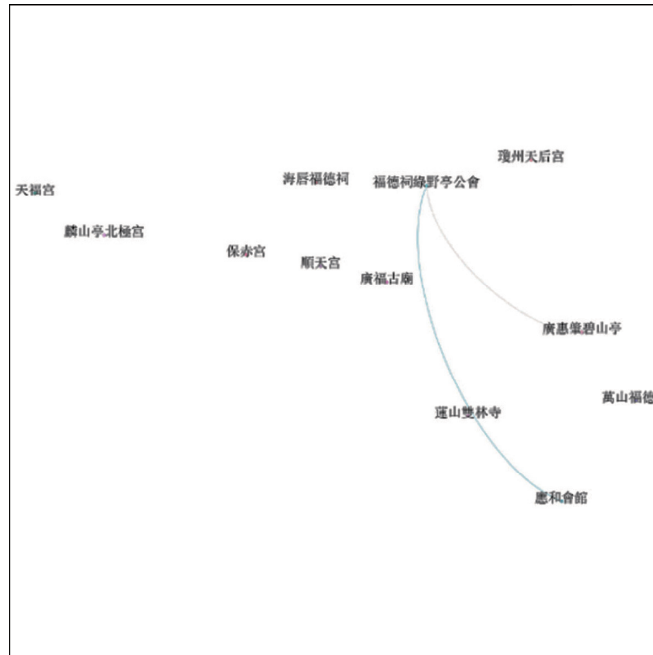


Figure 9a. Nodes With More Than 200 Edges

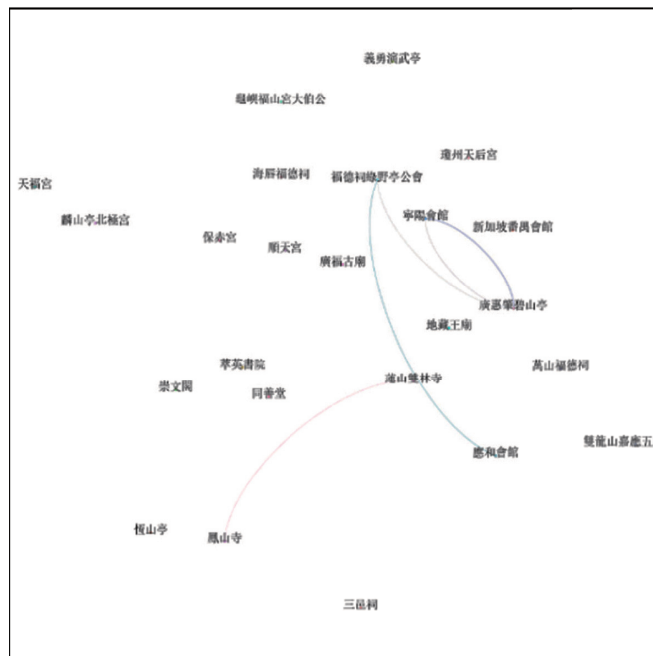


Figure 9b. Nodes With More Than 100 Edges

Figure 9. Different Layers of Social Network Image by Gephi



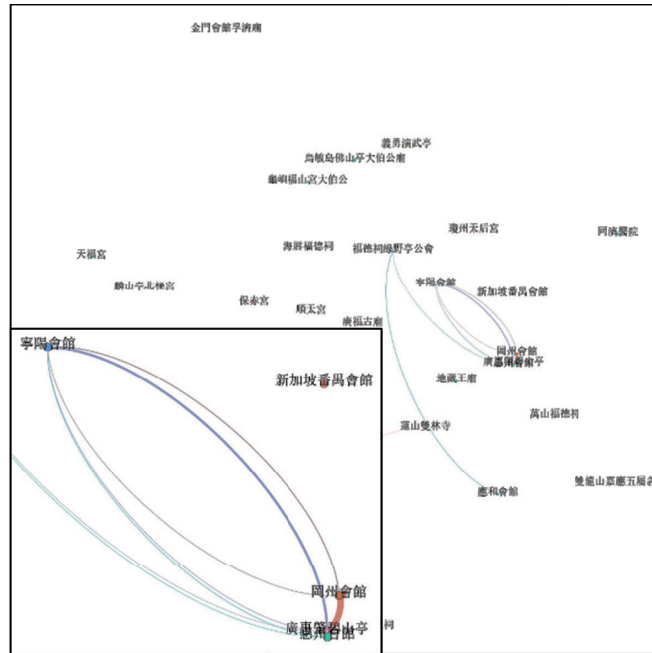


Figure 9c. Nodes With More Than 50 Edges

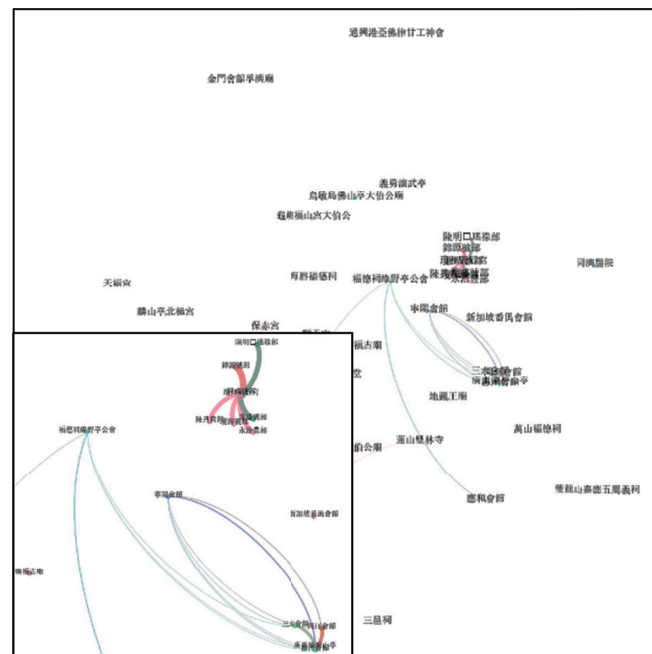


Figure 9d. Nodes with more than 20 Edges

Figure 9. Different Layers of Social Network Image by Gephi (continued)

Source: This study.

Temple 鳳山寺 (1868) and Lian Shan Shuang Lin Monastery 蓮山雙林寺 (1902) in this layer of network image. In Figure 9c, Kong Chow Wui Kun 瓊州會館 (1889) and Wue Chiu Fui Kun 惠州會館 (1903) appear. Lines between these two associations with Ning Yeung Wui Kuan 寧陽會館, Kwong Wai Siew Peck San Theng 廣惠肇碧山亭, and Hok Tek Chi Loke Yah Teng Association 福德祠綠野亭公會 are highlighted. In Figure 9d, Sam Sui Wui Kun 三水會館 (1903) is attested among the Cantonese associations. Moreover, some group donors with multiple records (each individual donation of the group was documented) are spotted, connecting to Kheng Chiu Tin Hou Kong.

Besides the “Weighted Degree”, nodes with higher value of “Betweenness Centrality” are “termed as a bridge” among clusters even not directly connected (Cherven, 2015, p. 188) with each other. Figure 10a and 10b are images based on the value of “Betweenness Centrality” of each node. In Figure 10a, 15 (out of 6,841) nodes are visible when the value of “Betweenness Centrality” is higher than 1,000,000 (till 600,000). They are all temples or associations. In Figure 10b, 23 nodes (8 more comparing to Figure 10a) are visible when the value of Betweenness Centrality is above 500,000. 德隆號 and 和興號 are the two stores appeared in this image. They are both connected with Hok Tek Chi Loke Yah Teng Association 福德祠綠野亭公會, Po Chiak Keng 保赤宮, and Soon Tian Keng 順天宮 (1902). The high value of Betweenness Centrality indicates high level of “traffic” of that point. In the perspective of Social Network Analysis, these associations are more active, having, therefore, more significant roles in a network. For example, the 15 temples and associations in Figure 10a mean they are the associations that people connect themselves with in order to enter the network. Moreover, Teck Leong 德隆號 and Woh Hing 和興號 are the two organizations with wider connections in the whole network. Kim Hing 錦興號 and Teck Guan 德源號 are attested when the value is set as 300,000.

In this experiment of network visualization, Gephi provides automatic calculations, such as merging the repetitive nodes and edges, frequency of nodes with the same weight. These results are projected to the network image generated by Gephi. Take the associations founded by Cantonese clan, for instance, the close relationship among these associations is visualized in both graphic presentation approaches mentioned above. In Palladio, the recurrent group donors are presented as one joint cloud with multiple target nodes inside, while generally one cloud of group donors has only one target node. On the other hand, in Gephi, these recurrent group donors are presented through lines, with different weights showing the scales of these minor communities.

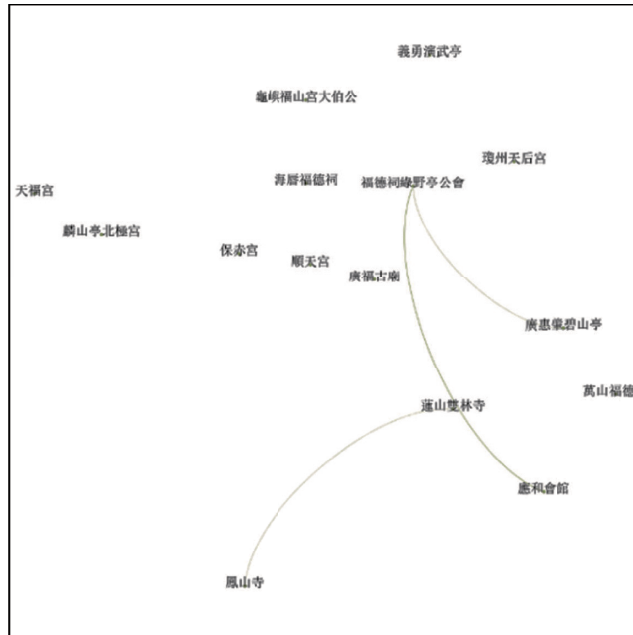


Figure 10a. Betweenness Centrality 1000000+

Source: This study.

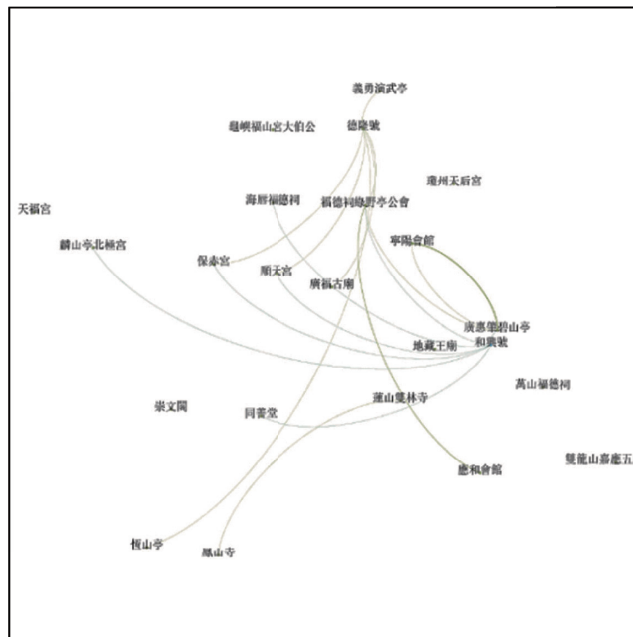


Figure 10b. Betweenness Centrality 500000+

Source: This study.

The author then applied a similar procedure to the individual donors. Among the 47,060 entries of individual donations elicited from the Chinese epigraphic texts, around 500 entries are with unclear characters or not identifiable for person names, such as those with only surnames readable. After the primary clean-up of data, 39,091 nodes (including the temples and associations, around 70) are read by Gephi. The Betweenness Centrality value of all these nodes is calculated as zero. Since there is no difference among the nodes according to “Betweenness Centrality”, the “Weight Out-Degree” is referred to in order to analyze the active level of each individual donor. The value of “Weight Out-Degree” shows how many donations each individual contributed. The one with highest “Out-weight Degree” value is “Low Kim Pong”, 30 records of donations. The node in the second place is 陳氏 (“female member of Tan/Chan/Chen Family”), 27 records of donations. Leong Yun Hou 梁元浩, a female member of Lim Family 林氏 (“female member of Lim/Lam/Lin Family”), a mother from Tan Family 陳氏娘, 19 records of donations, respectively. The following active individual donors include: Lau Siu Saan 劉少珊, 18 donations; 黃氏 (“female member of Ng/Wong/Huang Family”), 17 donations; Chin Kee Sun 曾紀辰 and Mok Tsok Sang 莫佐生, 16 donations; Kwok Geok Chuan 郭玉泉 and 李氏 (“female member of Lee/Li Family”), 15 donations. Among these names, the ones named as “female member from a certain family” are not identifiable as a person; it can refer to several persons with the same name. The different Romanized transliterations of these surnames are based on some major dialects in Singaporean Chinese context, namely: Hokkien/Teochew, Cantonese, and Mandarin (Skinner, 1951).

An interesting question about the network among donors is how the inter-community cooperation works, i.e., whether people are related to each other through multiple temples or associations. In Mak (1985, pp. 117-125), the community is defined according to dialects, and donation to multiple dialect clans is called “participation beyond clan (越幫參與)”. If a donor is attested in epigraphs of different dialectal clans, it is difficult to find out his origin of place.

The present study applies a computational approach to the original data, in order to categorize the individual donors according to parameters, before analysing them in cultural contexts. In contrast to “Weight Out-Degree”, “Out-Degree” value indicates to how many temples or organizations a person contributed to. According to this column, 95.51% individual donors donated to one organization, 3.68% donated to two organizations; 0.48% to three organizations, 0.11% to four

organizations, 0.04% to five, 0.01% to six.<sup>17</sup> When narrowing down the value of “Out-Degree” to five and six, only 17 nodes are visible. Besides the names for female members of a family (“林氏”, “李氏”, “吳氏”), Tang Kwong Sang 湯廣生 and Wong Thiam 黃添 donated to six organizations; Low Kim Pong, Choo Kwong Lan 朱廣蘭, Choo Yao Lan 朱有蘭, Loh Kei Sang 羅奇生; Tan Kim Chooi 陳金水 (late 1900s), Tan Soh 陳蘇, Chua Sam Tiong 蔡三重, Tan See Boo 陳四美, Ong Chwee Tow 王水斗, Chin Kee Sun 曾紀辰, Tan Thian Hock 陳天福, Tan Geok Eng 陳玉英 donated to five organizations.

The name attested in both lists of “most active” donors, according to “Weight Out-Degree” and “Out-Degree”, is Low Kim Pong. He has donated to four temples and one school and contributed 30 times to their related activities. Looking into the secondary neighbours of him, seven other individual donors are attested (Figure 12a). And in the third-level network of him, the nodes increase from 13 to 29, edges increase from 12 to 40, around half of the network shown in Figure 11 (51 nodes, 93 edges). In the second-level network of Low Kim Pong 劉金榜, the individuals include: Tan See Boo 陳四美, Chua Sam Tiong 蔡三重, Ong Chwee Tow 王水斗, Choo Kwong Lan 朱廣蘭, Choo Yao Lan 朱有蘭, Loh Kei Sang 羅奇生. In the third-level network of Low Kim Pong 劉金榜, the individuals remain the same, the increased nodes are organizations received donations from his secondary level neighbours. To some extent, contributing to the same temples/associations built up sort of network among these people. Most of the names listed here are documented celebrities in 1900s. Tan See Boo 陳四美 (1833–1884) was a Chinese missionary and pastor. Low Kim Pong 劉金榜 (1837–1909) was a wealthy trader and the leader of the Hokkien community. Ong Chwee Tow 王水斗 was known as a wealthy Hokkien pineapple tycoon. Choo Kwong Lan 朱廣蘭, Choo Yao Lan 朱有蘭, and Loh Kei Sang 羅奇生 are members of the seven leading merchants in Telok Ayer Mid-Street (“七家頭” in Chinese) from early 1900s.<sup>18</sup>

Low Kim Pong 劉金榜 was from Zhangzhou 漳州, Fujian Province. Ong Chwee Tow 王水斗 was from Dongshan 東山, Fujian Province. Choo Kwong Lan 朱廣蘭, Choo Yao Lan 朱有蘭, and Loh Kei Sang 羅奇生 were from Gugang 古岡 Prefecture (Xinhui 新會 County, Guangdong Province). The connections of Low Kim Pong 劉金榜 and Ong Chwee Tow 王水斗 with Choo Kwong Lan 朱廣

17 The node with highest “Out-Degree”, nine, is “陳氏”, not identifiable to be one person.

18 “Choo Kwong Lan” and “Choo Yao Lan” are brand names, which are much like person names and with known founders.

蘭, Choo Yao Lan 朱有蘭, and Loh Kei Sang 羅奇生, are through the Medical College of the Straits Settlements and the Federated Malay States 七州府醫學堂. In other words, the communication between Hokkien and Cantonese clans was through a medium beyond dialect communities.

Tong Kwong Sang 湯廣生 was a leader of the Cantonese clan according to the epigraphic texts. He donated to three associations, two lineage halls, and one temple. His secondary neighbours include Choo Kwong Lan 朱廣蘭, Choo Yao Lan 朱有蘭, Loh Kei Sang 羅奇生, Chin Kee Sun 曾紀辰, Wong Thiam 黃添, Tan Soh 陳蘇, Tan Geok Eng 陳玉英, and Tan Thian Hock 陳天福.

The active donors not yet attested in the network around a specific person is Tan Kim Chooi 陳金水 (late 1900s). This name has been attested in the epigraph in three temples, one lineage hall, and one school. His secondary neighbours

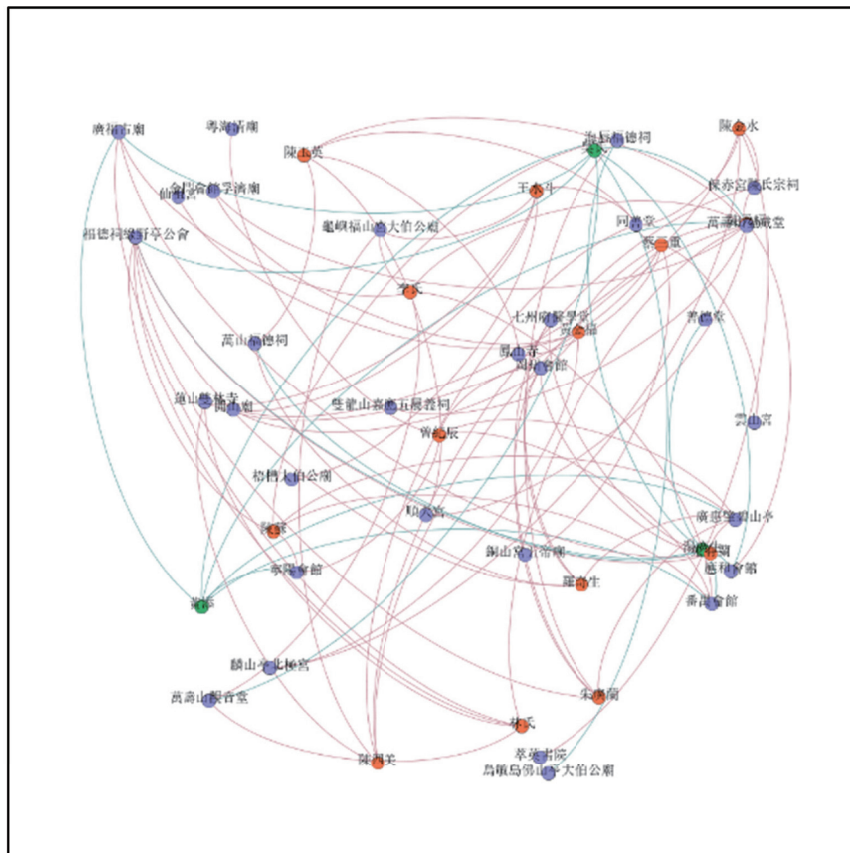


Figure 11. Network Among Active Donors (Out-Degree 5-6)

Source: This study.

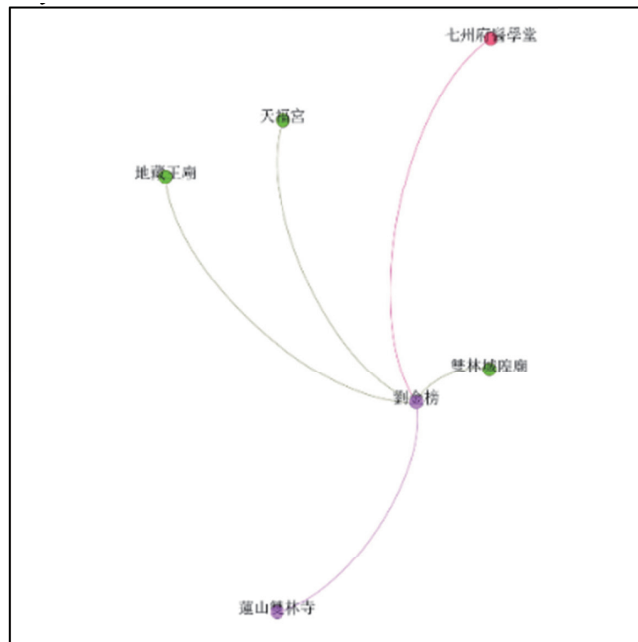


Figure 12a. Low Kim Pong 劉金榜 Level 1 Nodes

Source: This study.

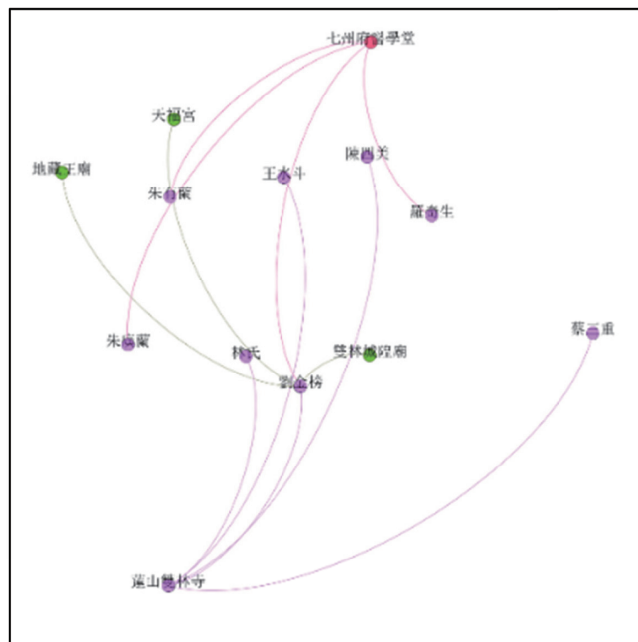


Figure 12b. Low Kim Pong 劉金榜 Level 2 Nodes

Source: This study.



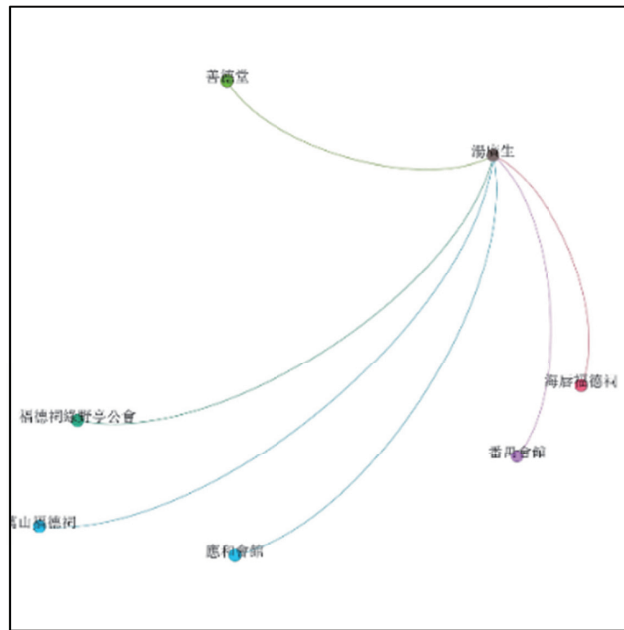


Figure 13a. Tong Kwong Sang 湯廣生 Level 1 Nodes

Source: This study.

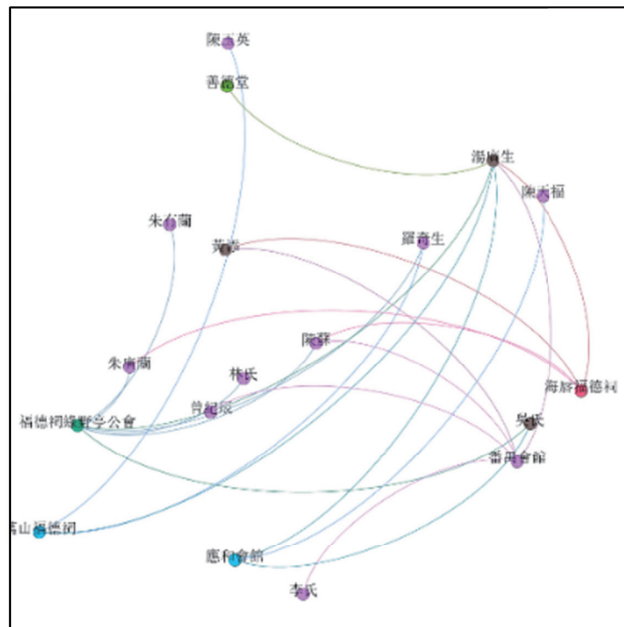


Figure 13b. Tong Kwong Sang 湯廣生 Level 2 Nodes

Source: This study.

include: Tan See Boo 陳四美, Ong Chwee Tow 王水斗, Chua Sam Tiong 蔡三重, as well as Tan Geok Eng 陳玉英, and Tan Thian Hock 陳天福. According to the nodes, this is a Hokkien community network.

## 5. Epigraphic Texts

The donors highlighted by Gephi as active nodes are potentially significant figures in pre-modern Singaporean history. However, some of them are not well-documented in other sources, e.g., Wong Thiam 黃添, Tan Soh 陳蘇, Chua Sam Tiong 蔡三重, Tan Thian Hock 陳天福, and Tan Geok Eng 陳玉英. Epigraphic texts provide information on the place of origin of the individual donors. Moreover, the four group donors with higher Betweenness Value (Teck Leong 德隆號, Woh Hing 和興號, Kim Hing 錦興號, Teck Guan 德源號) may be traditional commercial entities, and need to be identified in social contexts.

In these circumstances, epigraphic texts provide recordings of these donors, which can be used as original data to reconstruct their biographical information. For example, looking through the epigraphic texts, Teck Leong 德隆號 donated to seven organizations, from 1879 to 1907. Each donation was relatively a small amount comparing to other donors, from one silver dollar to fifty silver dollars. Woh Hing 和興號 is of the similar pattern: 11 relatively minor donations in 10 temples/associations, mainly in the period of 1854–1915, and one record in 1974.

Kim Hing 錦興號 made five donations in five temples/associations, between 1880 and 1907, among which three are relatively significant contributions. Teck Guan 德源號 made five donations in five temples/associations, between 1839

Table 1. Donation Records of Teck Leong 德隆號

Contribution	Date	Organization
卅元 (30)	光緒五年 (1879)	Heng San Ting 恆山亭 (No. 3.08)
伍元 (5)	光緒十年 (1884)	Hok Tek Chi Loke Yah Teng Association 福德祠綠野亭公會 (No. 7.04)
二十元 (20)	咸豐拾壹年 (1861)	Chui Eng Si E 翠英書院 (No. 17.02)
壹元 (1)	光緒六年 (1880)	Ancient Temple of Vast Fortune 廣福古廟 (No. 18.02)
五十元 (50)	民國十五年 (1926)	Po Chiak Keng 保赤宮 (No. 28.21)
十元 (10)	光緒二十八年 (1902)	Soon Tian Keng Temple 順天宮 (No. 48.02)
伍拾元 (50)	1907	Pavilion for the Practicing of Military Maneuvers 義勇演武亭 (Appendix 8)

Source: This study.

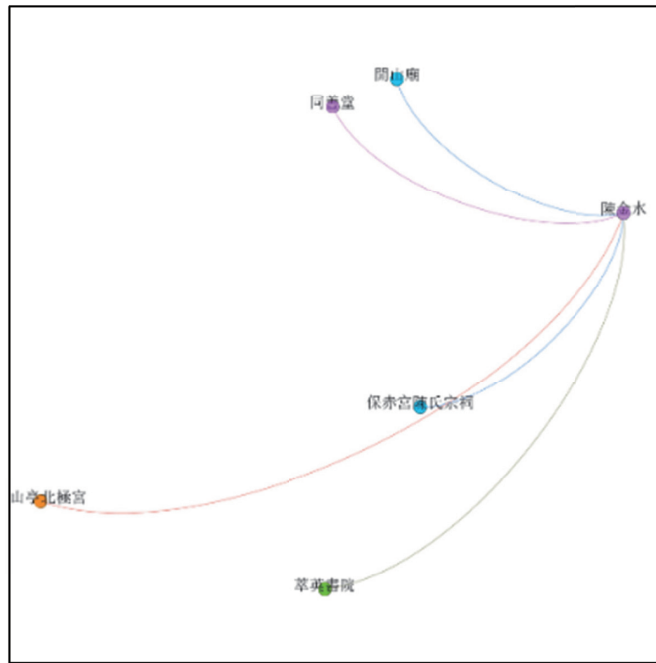


Figure 14a. Tan Kim Chooi 陳金水 Level 1 Nodes

Source: This study.

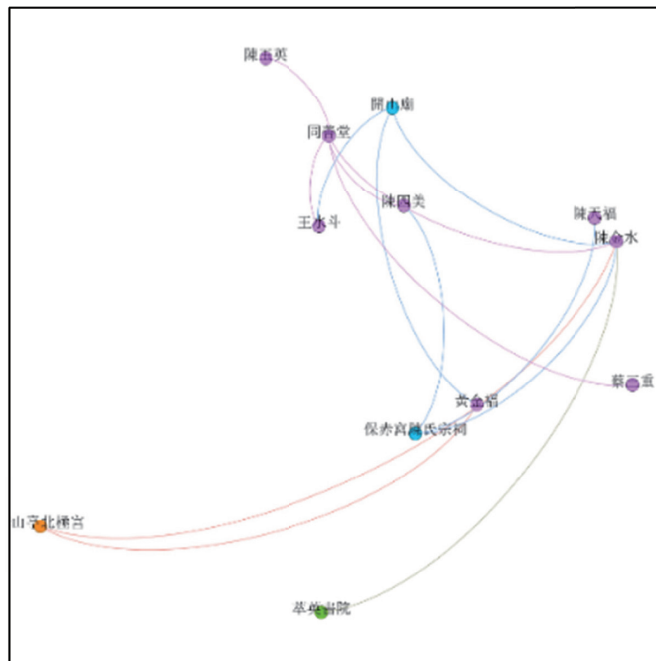


Figure 14b. Tan Kim Chooi 陳金水 Level 2 Nodes

Source: This study.

and 1894, and one in 1955. According to Chng (1986, pp. 13-14), Teck Guan 德源號 was located at #21 in Telok Ayer 直落亞逸 Street.

For the individual donors, the name Wong Thiam 黃添 was an active participant in temple constructions: Fuk Tak Chi Temple 福德祠, 1854 (No. 2.05); Ning Yeung Wui Kuan 寧陽會館, 1848 (No. 13.01); Ancient Temple of Vast Fortune 廣福古廟, 1880 (No. 18.02); Singapore Poon Yue Association 新加坡番禺會館 (No. 29.07), 1952; Kwong Wai Siew Peck San Theng 廣惠肇碧山亭, 1965 (No. 38.19); Kong Seng Ting Temple 萬壽山埜成堂, 1905 (No. 57.02). The donations were of relatively small amounts. The record of this name in Singapore Poon Yue Association 新加坡番禺會館 and Kwong Wai Siew Peck San Theng 廣惠肇碧山亭 are much later than the other recordings. Nevertheless, there are two people with the same name.

The similar situation is also attested checking through the epigraphic texts of Tan Soh 陳蘇 and Tan Geok Eng 陳玉英. The records of Tan Soh 陳蘇 spread in six temples/associations, from 1870 to 1965: two silver dollars to Fuk Tak Chi Temple 海唇福德祠 in 1870 (No. 2.30, two entries of the same name); one silver dollar to Hok Tek Chi Loke Yah Teng Association 福德祠綠野亭公會 in 1884 (No. 7.03); contributed to a plaque as a member of Hoi Tin Entertainment Association 海天遊藝會 in 1892 (No. 13.17); four silver dollars to Singapore Poon Yue Association

Table 2. Donation Records of Kim Hing 錦興號 and Teck Guan 德源號

Contribution	Date	Organization
Kim Hing 錦興號		
勸捐題 副才 (Vice Organizer, Calling for Donation)	光緒六年 (1880)	Ancient temple of Vast Fortune 廣福古廟 (No. 18.02)
壹佰貳拾員 (120)	同治七年 (1868)	Hong San See 鳳山寺 (No. 21.01)
伍員 (5)	光緒十六年 (1890)	Kwong Wai Siew Peck San Theng 廣惠肇碧 山亭 (No. 38.02)
十元 (10)	光緒二十八年 (1902)	Soon Tian Keng Temple 順天宮 (No. 48.02)
壹佰元正 (100)	1907	Pavilion for the Practicing of Military Maneuvers 義勇演武亭 (Appendix 8)
Teck Guan 德源號		
壹佰卅元 (120)	光緒五年 (1879)	Heng San Ting 恆山亭 (No. 3.07)
壹拾大元 (10)	道光十九年 (1839)	Kim Lan Temple 金蘭廟 (No. 4.02)
伍佰元 (500)	壹仟玖佰伍拾伍年 (1955)	Thian Hock Temple 天福宮 (No. 6.53)
十六元 (16)	同治柒年 (1868)	Siang Cho Keong Temple 仙祖宮 (No. 20.2)
貳拾伍員 (25)	光緒二十年 (1894)	Tong Sian Tng Temple 同善堂 (No. 42.01)

Source: This study.

新加坡番禺會館 in 1879 (No. 29.01) and 12 silver dollars in 1952 (No. 29.06); a member of the executive organizers for the Singapore Great Ritual for the Saving of Secluded Souls and the Resolving of the Myrad Karmic Entanglements of the Kwong Wai Siew Peck San Theng 廣惠肇碧山亭 in 1965 (No. 38.19) and 1978 (No. 38.21). The records of Tan Geok Eng 陳玉英 include: 100 dollars to Hong San See Temple 鳳山寺 in 1996 (No. 21.16); 100 dollars to Mun San Fook Tuck Chee 萬山福德祠 in 1985 (No. 40.18); 3 dollars to Tong Sian Tng Temple 同善堂 in 1898 (No. 42.02); 100 dollars to Soon Tian Keng 順天宮 in 1997 (No. 48.07); not recognizable amount to Kong Seng Ting Temple 萬壽山埜成堂 in 1905 (No. 57.02). According to the long-time span of the records, it is possible that these names refer to different persons.

Tan Tian Hock 陳天福 reveals to be a contemporary person. His donations are made between 1953 and 1997: 100 dollars to Ying Fo Hui Kun 應和會館 in 1994 (No. 8.10); 3000 dollars to Kim Mui Hoey Kuanin 金門會館 in 1987 (No. 25.10); 5 dollars to Wu Shu Temple 雙龍山嘉應五屬義祠 in 1953 (No. 27.30); 500 dollars to Po Chiak Keng 保赤宮 in 1983 (No. 28.31); 100 dollars to Soon Tian Keng 順天宮 in 1997 (No. 48.07).

Chua Sam Tiong 蔡三重 is also a figure lacks of historical documentations. However, according the epigraphic texts, he made several crucial contributions. Table 3 displays the six records of him, related to five temples/associations of Hokkien clan. According to the temples he donated to, he could be Hokkien.

## 6. Conclusions

The present study applies several digital humanities approaches to the frequency analysis of sponsors attested in the epigraphy in pre-modern Chinese Singaporean Temples. It is an exploratory attempt to analyse the social

Table 3. Donation Records of Chua Sam Tiong 蔡三重

Contribution	Date	Organization
總理 (President); 良式拾伍 (25)	民國二年 (1913)	Hong San See 鳳山寺 (No. 21.07)
緣銀貳佰元 (200)	光緒三十年 (1904)	Tong Sian Tng 同善堂 (No. 42.03)
貳百八十元 (280)	天運庚申年 (1920)	Lian Shan Shuang Lin Monastery 蓮山雙林寺 (No. 45.84)
大銀乙十元 (10)	光緒廿八年 (1902)	Hoon San Temple 雲山宮 (No. 47.02)
緣銀三十六元 (30)	光緒廿二年 (1886)	Copper Mountain Temple of the Martial Emperors 銅山宮 武帝廟 (Appendix 6)

Source: This study.

network imbedded in the big amount of biographical data with computational perspectives.

The combination of XML and Python can generate exhaustive and detailed data about donors, organizations, years, amounts, at the condition that the details are within specific labels. The limit of this methodology consists of the fact that the preparation of the marked-up text following TEI standard can be quite long, and it requires skills in programming.

DocuSky provides an automatic calculation of the frequency of multiple terms in the text, including the times they appear and the number of files containing them. The results are not final, though. In order to get the frequency of person names or organization names, the texts under analysis should be pure epigraphic inscriptions.

Palladio is an easy and intuitive platform for making network images. The user needs to modify the dataset according to various research purposes. Gephi, on the other hand, processes the original data following the framework of Social Network Analysis. Based on one image project, the user can look into different layers and different versions of the network, by setting the parameters. Besides, Gephi has stricter requirements on Chinese characters. Some of the characters included in the extension list of Unicode are not recognized by default character database, and can lead to wrong calculations.

These digital humanities approaches equip research involves big amount of data. They help in batch elicitation, statistic calculation (therefore, categorization), and visualization. According to computational analyses, digital humanities tools highlight potentially significant nodes based on statistics. Then, in order to understand the role of these nodes in the social network, it is necessary to go back to the epigraphic texts. These texts provide vivid information, including different phases of their lives, for tracing back the biographic histories of these individuals. As mentioned so far, manual work is unavoidable though, in both data preparation and data analysis. Nevertheless, these initial results guide the researchers to further exploration in an accelerated manner. For a more detailed data preparation, in order to generate results with more specific focus, the group donors can furtherly be divided into three categories: business organizations, associations, and folk communities. Moreover, date can be added to the parameters of each node.

At the current stage, the author highlighted the different patterns of founding temples or association by Cantonese and Hokkien clans. The inter-

community activities are more likely attested at public organizations, like schools, instead of temples, associations, and lineage halls. Most of the active donors are significant figures, while some of them are common civilians participating broadly among the community activities. Some of the celebrities in history lack of documentation for some reasons. For those cases, such study can lead to the fill-up of these biographical blanks.



## References

- Bastian, M. (2008). Gephi. Retrieved from <https://gephi.org/>
- Cameron, J. (1865). *Our tropical possessions in Malayan India*. London: Smith, Elder.
- Chen, J. H., & Chen, Y. S. (1970). *Xinjiapo Huawen Beiming Jilu* 新加坡華文碑銘集錄 [A Collection of Chinese epigraphy in Singapore]. Hongkong, China: Chinese University of Hong Kong Press.
- Cheng, L. K. (1985). *Social change and the Chinese in Singapore: A socio-economic geography with special reference to Bāng Structure*. Singapore: Singapore University Press.
- Cheng, L. K. (2019). Traditional religious beliefs, emigration and the social structure of the Chinese in Singapore. In C. G. Kwa & B. L. Kua (Eds.), *A general history of the Chinese in Singapore* (pp. 479-500). Singapore: World Scientific.
- Cherven, K. (2015). *Mastering Gephi network visualization*. Birmingham, UK: Packt.
- Chng, D. (1984). *Xinjiapo Huawen Mingke Jilu Chubian* 新加坡華文銘刻集錄初編 [A preliminary collection of Chinese epigraphy in Singapore]. *Proceedings of Humanities and Social Sciences*, 4, 73-108.
- Chng, D. (1986). *Xinjiapo huarenshi luncong* 新加坡華人史論叢 [Collected essays on Chinese in nineteenth century Singapore]. Singapore: South Seas Society.
- Dean, K. & Hue, G. T. (2017). *Xinjiapo huawen mingke huibian: 1819–1911* 新加坡華文銘刻彙編：1819–1911 [Chinese epigraphy in Singapore: 1819–1911]. Singapore: NUS Press.
- Goncharov, I. A. (1987). *The frigate Pallada* (K. Goetze, trans.). New York: St. Martin's Press. (Original work published 1879)
- Hughes-Hallett, H. R. (1940). A sketch of the history of Brunei. *Journal of the Malayan Branch of the Royal Asiatic Society*, 18(2), 23-42.
- Humanities + Design, Stanford University. (n.d.). Palladio. Retrieved from <http://hdlab.stanford.edu/palladio/>
- Jao, Ts. I. (1994). *Xinjiapo gushiji* 新加坡古事記 [The Chinese sources for

- the history of Singapore before 1912]. Hongkong, China: The Chinese University of Hong Kong.
- Kua, B. L. (1995). *Xinhua Lishi Renwu Liezhuan* 新華歷史人物列傳 [Historical figures of Singaporean Chinese]. Singapore: Jiaoyu Chuban Siying Gongsi.
- Lim, H. S. (2019). Social structure and bang interactions. In C. G. Kwa & B. L. Kua (Eds.), *A general history of the Chinese in Singapore* (pp. 115-134). Singapore: World Scientific Publishing.
- Lim, H. S. et al. (1975). *Shile Guji* 石叻古跡 [Historic sites of the Republic of Singapore]. Singapore: South Seas Society.
- Lin, B. A. et al. (Eds.) (1922-1941). *Nanyang Mingren Jizhuan* 南洋名人集傳 [Biographies of prominent Chinese in southeast Asia] (Vols. 1-5). Penang, Malaysia: Nanyang Minshi Zuanxiu Guan.
- Lin, Y. H., & Zhang, Y. L. (2008). *Xinjiapo Malaixiya Huaqiao Shi* 新加坡馬來西亞華僑史 (A history of overseas Chinese in Singapore and Malaysia). Guangzhou, China: Guangdong Higer Education Press.
- Mak, L. F. (1981). *The sociology of secret societies: A study of Chinese secret societies in Singapore and Peninsular Malaysia*. New York, NY: Oxford University Press.
- Mak, L. F. (1985). *Fangyanqun renting: Zaoqi xingma huaren de fenleifaze* 方言群認同：早期星馬華人的分類法則 [Dialect group identity: A study of Chinese subethnic group in early Malaya]. Taipei, Taiwan: Institute of Ethnology of Academia Sinica.
- National University of Singapore, National Library, Singapore, & Singapore Federation of Chinese Clan Associations. (2019). Singapore Biography Database (SBDB). Retrieved from <http://sbdb.nus.edu.sg/>
- Python Software Foundation. (n.d.). Python. Retrieved from <https://www.python.org/>
- Raffles, S. (1830). *Memoir of the life and public services of Sir Thomas Stamford Raffles*. London, UK: John Murray, Albemarle Street.
- Research Center for Difital Humanities, National Taiwan University. DocuSky & Digital Archives and Automated Reasoning Laboratory, Department of Computer Science and Information Engineering, National Taiwan University. (n.d.). DocuSky. Retrieved from <http://docusky.org.tw/>

DocuSky/ds-01.home.html

Skinner, G. W. (1951). *Report on the Chinese in Southeast Asia, December 1950*. Ithaca, NY: Southeast Asia Program, Department of Far Eastern Studies, Cornell University.

Song, O. S. (1984). *One Hundred Years' History of the Chinese in Singapore*. Singapore: Oxford University Press.

Text Encoding Initiative Consortium. (2019). *TEI P5: Guidelines for Electronic Text Encoding and Interchange*. Retrieved from <https://tei-c.org/release/doc/tei-p5-doc/en/html/index.html>

Wasserman, S., & Faust, K. (1994). *Social network analysis: Methods and applications*. Cambridge, UK: Cambridge University Press.

Xu, D., Bond, F., & Dean, K. (2019). *Combination of TEI and Python in studies of Chinese epigraphy in Singapore*. Paper presented at the 2019 Pacific Neighborhood Consortium Annual Conference and Joint Meetings. Singapore.

# 新加坡華人廟宇碑銘所載芳名錄的 數位人文探索

許多多<sup>1,\*</sup>、丁荷生<sup>2</sup>、馬德偉<sup>3</sup>、Francis Bond<sup>4</sup>

## 摘 要

華人廟宇碑銘是新加坡近代社會歷史面貌的重要文獻。因其浩繁的數據而尚未有全面深入的分析。本文旨在就近代新加坡華人廟宇碑刻銘文所載芳名錄進行頻率分析。頻率分析包括考察捐贈者的參與次數、社會關係、以及活動範圍（相關聯的廟宇）。此研究運用數位人文的多種工具，包括文本編碼規範（TEI-Text Encoding Initiative）、Python、DocuSky，以及 Palladio。文本編碼規範用於標記和整理《新加坡華文銘刻彙編 1819–1911》的原始文本。繼而可以通過 Python 程式提取添加了不同標籤的資訊。從原始文本中提取的訊息在 DocuSky 平台可進行捐贈者的頻率分析。Palladio 和 Gephi 為捐贈者的社會網絡關係提供圖示化呈現。此研究運用數位人文的視角探究新加坡早期華人社群的不同面向。

**關鍵詞：**華人廟宇、捐贈者頻率分析、數位人文、文本編碼規範、Python、DocuSky、Palladio、Gephi

---

投稿日期：2019 年 11 月 25 日；通過日期：2020 年 3 月 16 日。

<sup>1</sup> 新加坡南洋理工大學博士後研究員

<sup>2</sup> 新加坡國立大學中文系教授

<sup>3</sup> 美國天普大學宗教系 副教授、文本編碼設計師

<sup>4</sup> 新加坡南洋理工大學語言學與多語研究中心副教授

\* 通訊作者：許多多，duoduo.xu@ntu.edu.sg