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Title of Paper

Big Data for Market Frame Creation

Abstract

Last year 2017 Indonesia has carried out listing of traditional market and modern market. It was collected by regional statistical office in every district and big city then transfer to NSO to be compiled as a market directory. Big data, such as Places API from Google Maps Platform can efficiently be utilized to create market frame. The data collected can be used to list market directory, and also are able to precisely provide other supporting data such as address and coordinate location. Indonesia by ministry of interior definition has a hundred big cities and four hundred districts. The mention of market could be different in each region. Hence, keyword has an important role in market seeking. Other software are involved to preserve the desirable market directory and to extract data output. Next cleaning data is applied to prevent duplicate data. We compare the market data result of this method with the market directory produced by National Statistical Office (NSO) of Indonesia for Bandung city that has 27 markets listed, Medan city that has 78 markets listed, and Makassar city that has 19 markets listed. The results show that Bandung city has 32 markets, which 19 of them are matched, but 8 of them are listed in the market directory but not registered in Places API list, the rest 13

markets are not listed in the directory but registered in Places API. The other cities, Medan and Makassar, show quite similar results. This case of unregistered data become a challenge that will be followed up for the next research. In conclusion, big data could be used to obtain the completion of market directory that has been published. It may even replace the conventional method in the future.

Keywords: *Big Data, Market, Frame, Google Places API*

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Introduction

In 2017, National Statistical Office (NSO) of Indonesia conducted market listing in every province in Indonesia in order to obtain market frame for survey. It was very costly because the information of markets name was obtained by visiting legal trade institution, trade association, and other stakeholders in every district and big city. However, the NSO has not used big data for market listing.

Nowadays big data grows very fast and appears from many range of sources. According to Pingdom, (2013), there are more than 38.000 searchings on Google on a daily basis. Big data can give a chance for NSO to become more productive and efficient.

One of big data sources is Google Maps, which is a web mapping service developed by Google that also provides places landmarks, such as restaurants, hospitals, office buildings, and also markets. Google Maps contains reviewed content from various sources, which include information from partners, users, or the public web. The Places API from Google Maps Platform is a service that returns information about places as establishments, geographic locations, or prominent points of interest. We use that information to be an economic establishment frame that will be very useful for NSO and also other data users, both government and private.

The purpose of this research is to compare the traditional market directory resulted from big data, such as Places API and the traditional market directory resulted by NSO which was applied conventionally as a reference in order to find the better and efficiently used method for the future.

Literature Review

Market Frame

Market listing from NSO in 2017 is a complete data collection activity in every province in Indonesia. All of the information was gathered to obtain the number of markets by its type, and also to obtain market frame for survey. This activity cover into two different types of market: Traditional Market and Modern Market, which also divided into Shopping Center and Modern Shop. Especially for Modern Shop, these kind of market were obtained if at least has floor area for about 400 m². Conducted market listing gathered not only its region of each market but also its characteristic, such as name, address, commodity, and year the building is lastly were renovated.

According to Permendag No: 70/M-DAG/PER/12/2013, market is a place of sale and purchase of goods with more than one number of sellers, both referred to as shopping centers,

malls, plazas, trade centers or other (Ministry of Trade Republic of Indonesia, 2013). Based on law UU No. 7 of 2014 concerning trade, market is an economic institution where buyers and sellers meet, both directly and indirectly, to make sales transactions (President of the Republic of Indonesia, 2014).

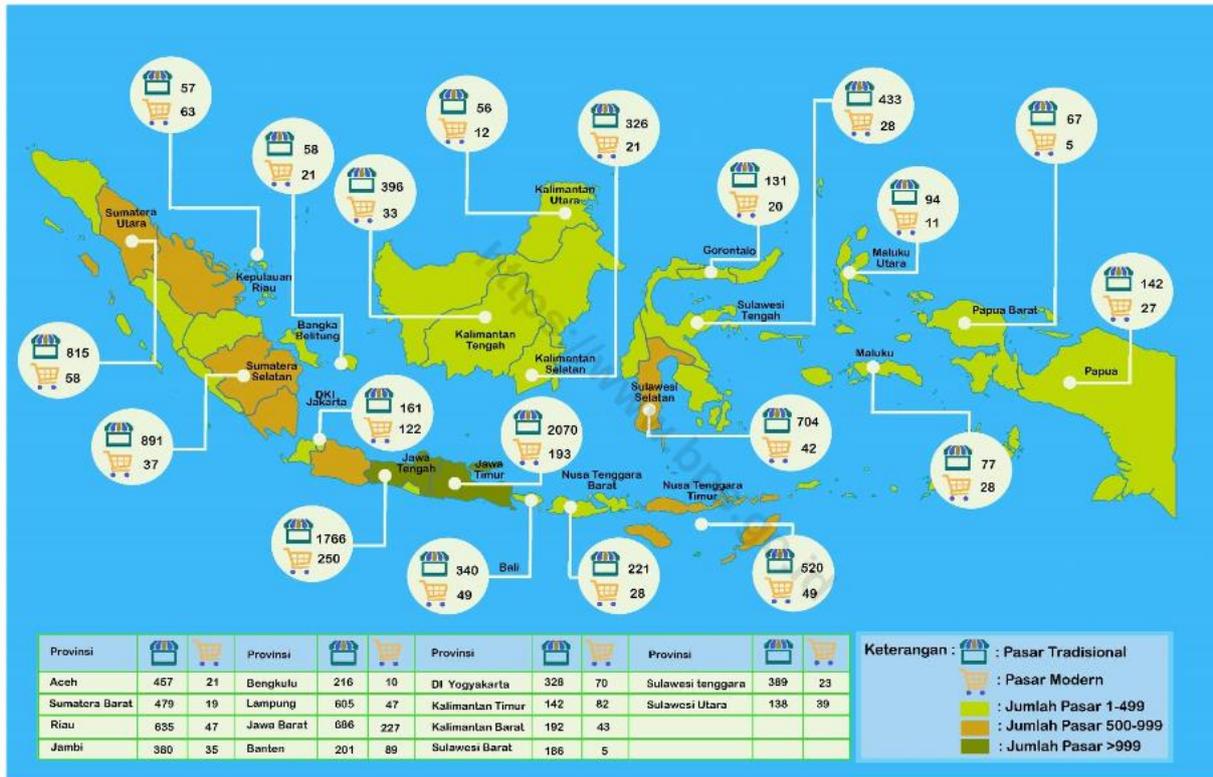


Figure 1. Market Distribution Across Indonesia (NSO, 2017)

Market directories were collected and updated from pre-printed list of market by visiting legal trade institution, trade association, and other stakeholders in every district and big city. The pre-printed list contains the name and address of the market originating from various sources like Economic Census 2016 (BPS - Statistics Indonesia, 2018) or trade association like Asosiasi Pengelola Pasar Indonesia (Asparindo, 2017), but NSO has not utilized big data. The data is collected by regional statistical office in 514 district and big city across Indonesia, which at least involve one employee as an officer in each office. It is unfortunate that the NSO did not carry out this activity by searching directly into the field and conducting several ground checks from the listed market due to time-consuming and costly.

NSO began conducting this activity in 2017 and it is planned will be updated annually. Market directories has the purpose of forming market frames for use in surveys such as price surveys and other economic surveys. In addition, the frame is also used to survey market

profiles that describe market characteristics to determine the design of market revitalization programs that will be carried out by related institutions. In 2017, NSO mentioned that there are 16,213 a number of markets spread across Indonesia, and only about 1 percent are inactive and are being renovated.

Google Places API

Google Maps is a web mapping service developed by Google that provides satellite imagery, aerial photography, street maps, 360° panoramic views of streets (Street View), real-time traffic conditions, and route planning. Google Maps also provides places landmarks, such as restaurants, hospitals, office buildings, and also markets. It builds with reliable and comprehensive data for over 200 countries and territories with 99% coverage of the world. The data itself contains 25 million updates daily and count on accurate, real-time location information with 1 billion monthly active users (Google, 2019). Google Maps contains reviewed content from various sources such as information from partners, users, or the public web. Google review and remove content if they learn that it violates content policies or if it violates applicable laws.

The Places API from Google Maps Platform is a service that returns information about places as establishments, geographic locations, or prominent points of interest (Google, 2019). It returns information about places using HTTP requests and returns either a JSON or XML response. All requests to a Places service must use the https:// protocol and include an API key. The API key is used to track API requests associated with the project for usage and billing. The following place requests of this API:

- Place Search returns a list of places based on a user's location or search string.
- Place Details returns more detailed information about a specific place, including user reviews.
- Place Photos provides access to the millions of place-related photos stored in Google's Place database.
- Place Autocomplete automatically fills in the name and/or address of a place as users type.
- Query Autocomplete provides a query prediction service for text-based geographic searches, returning suggested queries as users type.

Enterprise Architect's Guide

Today, big data is commonly defined as data that contains a greater variety arriving in increasing volumes and with ever higher velocity. Data growth, speed, and complexity are

being driven by the deployment of billions of intelligent sensors and devices and by other sources of semi-structured and structured data. The data must be gathered on an ongoing basis, analyzed, and then provide direction to the business regarding appropriate actions to take, thus providing value.

To deliver to business requirements and provide value, architects must evaluate how to efficiently manage the volume, variety, velocity of this new data across the entire enterprise information architecture. Oracle made an introduction to the big data ecosystem and the architecture choices that an enterprise architect that represent on their holistic capability map (Oracle, 2016).

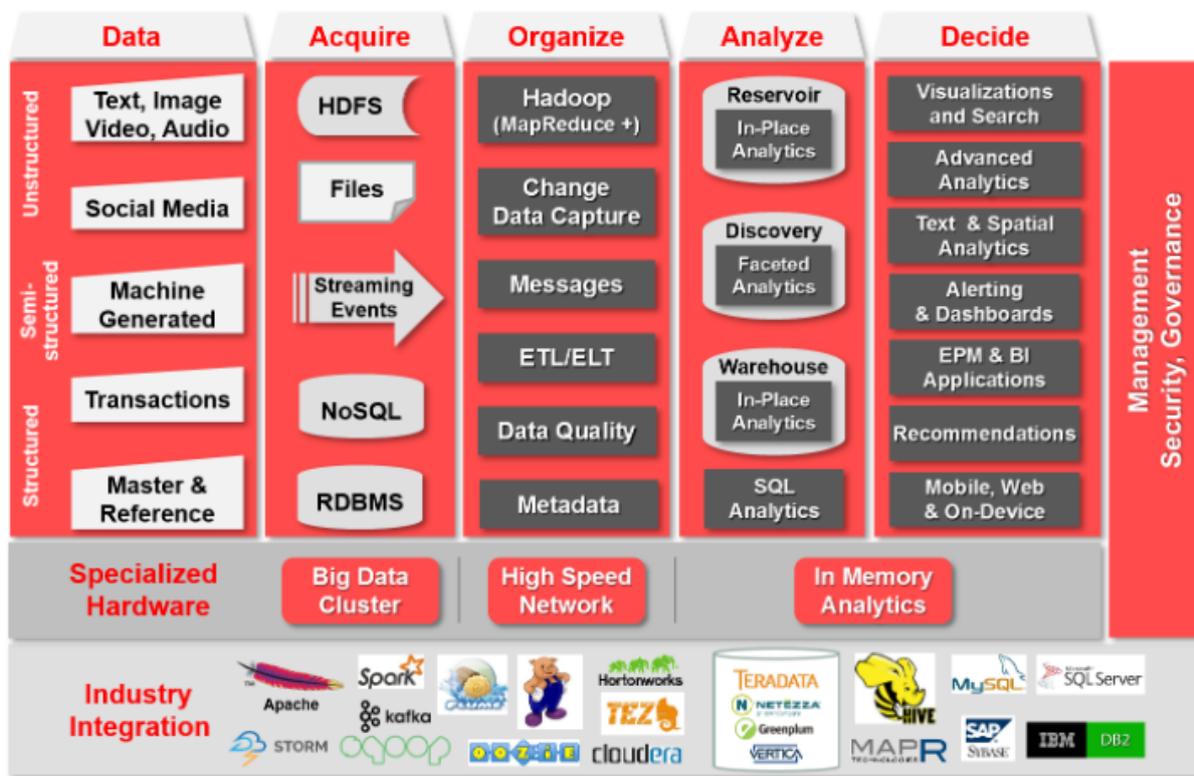


Figure 2. Oracle's Unified Information Management Capabilities (Oracle, 2016)

Acquire, is the stage to ingest all data, either structured, semi-structured, or unstructured and can be written directly (real-time) into memory processes or to disk as messages, files, or database transactions. Once received, the data can be written to the file system, a traditional RDBMS, or distributed-clustered systems. Organize, is the stage to manage big data to be more structured and simpler in a storage media for further analysis, just as the transaction data. Analyze, is the stage of analyzing the “reduction-results” that are loaded from the previous step. This stage is equipped with sophisticated analysis and

sophisticated visualization. Decide, is a report and dashboard preparation for decision making. This stage is equipped with interactive, real-time, and data modeling tools. These tools include advanced analytics, in-database, and in-reservoir statistical analysis, and advanced visualization, in addition to the traditional components such as reports, dashboards, alerts and queries.

Matching Existing Directory with Big Data

As a list of all units of a population, sampling frame provides quantitative information for the estimation of population parameters. Ideally, a sample frame should be one that is complete, accurate and up to date. To date, NSO still uses a conventional way to update sampling frame. It needs a lot of time, cost and labour. Therefore, a new better way should be introduced. One of the solutions is using big data as an alternative way to be complementary of the current process and to simplify the task, Putra et al (2018).

In his research, Putra did matching accommodations directory from NSO and scraped data from Agoda directory. From the result of the matching process, Putra find in Bali Province there are 1,516 accommodations match between existing directory from NSO and scraped data. But there are also for about double times than the matched were not included both on scraped data through Agoda and existing directory from NSO. So it is interesting that combining both approaches will gain more complete, accurate, and up to date directory for frame creation.

Methodology

Acquire

Extracting data is applied to obtain a market directory from Google Maps, which is processed through Places API from Google Maps Platform. Places are defined within this API as establishments, geographic locations, or prominent points of interest. The services is accessed as an HTTP request, and returns either a JSON or XML response, and include an API key. In this research, we use the free version plan of an API to run the request, so there are some limitations according to the result.

The following place requests to obtain the market directory we applied is Place Search request. Place Search returns a list of places based on a user's location or search string. From all of the Place Search request, we use a Nearby Search request. This request can search for places within a specified area and keywords or specifying the type of place (Google, 2019). By default, each place search returns up to 20 results per query. However, each search can return

as many as 60 results, split across three pages. Based on this limitation, we are not able to search the whole market directory at once. Then we have to separate each search area and define its coordinates (longitude and latitude) to be included alongside the keyword to obtain the Place Search result as we want. The keyword parameter is matched to: *name*, *type*, *address*, and *customer reviews*. Therefore the keyword itself is important to get the desired results, so we need to add the keyword *pasar*, which is directly translated as the market in Bahasa.

We also made some additional keyword in some particular region since the mention of market is different due to local language influence. Here is some of the list of word “market” in local language by province region:

- Aceh : *pasai, peukan*
- Sumatera Utara : *poken, onan, tiga, pajak*
- Lampung : *pecan, pasagh*
- Sumatera Barat : *pasa, pakan*
- Sumatera Selatan : *kalangan*
- Jawa Tengah : *peken*
- Bali : *peken*
- Nusa Tenggara Barat : *amba*
- East side of Indonesia : *market*

Place search request includes types of place in their return result based on their list supported place types. According to this, actually we can easily extract market directory based on this criteria, but unfortunately, Google has not added “market” as their supported place types. But Google also provides the function to add the category type to a place by the user, once the edit has been approved and published then it will appear using the correct type filtering. In Addition, there are some places returned the type categorized as “establishment”, which are not listed as supported place types. Fortunately, this is the way Google categorizing those places until Google has enough data about a place to categorize it as one of the supported place types. Here is the list supported places types:

- accounting
- airport
- amusement_park
- aquarium
- art_gallery
- atm
- bakery
- bank
- bar
- beauty_salon
- bicycle_store
- book_store
- bowling_alley
- bus_station
- cafe
- campground
- car_dealer
- car_rental
- car_repair
- car_wash
- casino
- cemetery
- church
- city_hall
- clothing_store
- convenience_store
- courthouse
- dentist
- department_store
- doctor

- electrician
- electronics_store
- embassy
- fire_station
- florist
- funeral_home
- furniture_store
- gas_station
- gym
- hair_care
- hardware_store
- hindu_temple
- home_goods_store
- hospital
- insurance_agency

Next, in order to get the market directory by region, we need to define its coordinates to represent each region, we call it midpoint. To minimize the result from outside the region, we also define a circle radius for each midpoint. There are some calculations to find the midpoint and the circle radius of an area as we show in the following steps for Makassar City.

First, we determine the outermost point of Makassar city map as shown by the red dot in Figure 3. The northernmost point is point A with coordinates (p, q), the easternmost is point B (r, s), the southernmost C (t, u), and the westernmost is point D (v, w). Then we create a rectangular area with its vertices and coordinates: E (v, q); F (r, q); G (r, u); H (v, u). After that, we specify the midpoint of the city, namely point X with coordinates (m, n). The m coordinate is calculated by $m = (v + r) / 2$ and the n coordinates are calculated by $n = (u + q) / 2$. Then we find the radius by measuring the distance between X and H. The distance is measured by $m-v$ then converted to meters, becomes y meters, $n-u$ then converted to meters, becomes z meters. The radius becomes the result of $= \sqrt{y^2 + z^2}$.

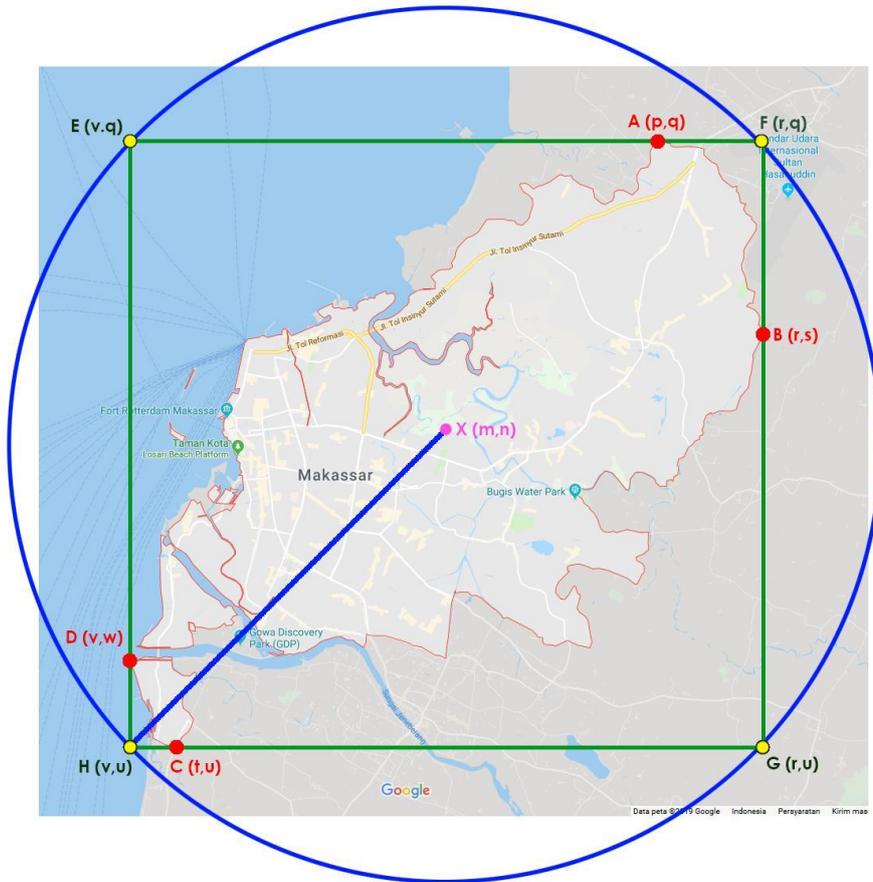


Figure 3. Visualization to get midpoint and circle radius for Makassar City

In this research, we only used three different regions to study, Medan City represented West Indonesia, Bandung City represented Central Indonesia, and to represents Eastern Indonesia, we used Makassar City.

Table 1. Midpoint and Distance Circle Radius Across Region

No	Region	Midpoint		Radius (distance between X and H)
		Latitude	Longitude	
(1)	(2)	(3)	(4)	(5)
1	Medan City	3.56523925	98.6694865	12.095,1134 m
		3.71939375	98.6694865	12.095,1134 m

2	Bandung City	-6.904361	107.589389	18.309,7969 m
		-6.904361	107.687139	18.309,7969 m
3	Makassar City	-5.139755	119.461202	12.483,8678 m

After certain required parameters are complete, then we extract the market directory for each region by its own midpoint, circle radius, and keyword. The output of the service will return either as a JSON or XML, but we choose to use JSON instead. The following place search request response contains the *geometry*, *name*, *photos*, *types*, and *vicinity*. The request for each midpoint is running on Kofax Kapow™ and were returns as a JSON files. Each midpoint search may be represented by one to three JSON files according to its number of places returns.

```

GET https://maps.googleapis.com/maps/api/place/nearbysearch/json?
location=-6.904361,107.589389&radius=18309.7969&keyword=pasar&key=[redacted]

2  "html_attributions": [],
3  "next_page_token": "CpQEDwIAAJKqotpeU4d4v5Xj8ItcwT4_qa2orxA0IEeGqf5CyfA7iXszXrxStDr_azyNrKEbXN1n3ZJKdSAy54Z7M",
4  "results": [
5    {
6      "geometry": {
7        "location": {
8          "lat": -6.884838,
9          "lng": 107.6140941
10       },
11      "viewport": {
12        "northeast": {
13          "lat": -6.884838,
14          "lng": 107.6140941
15        },
16        "southwest": {
17          "lat": -6.884838,
18          "lng": 107.6140941
19        }
20      },
21      "icon": "https://maps.gstatic.com/mapfiles/place_api/icons/shopping-71.png",
22      "id": "8c70b3f6ec8401d34f172883baccf614c4b3afc6",
23      "name": "Pasar Tradisional Simpang Dago",
24      "opening_hours": {
25        "open_now": true
26      },
27      "photos": [
28        {
29          "photo_reference": "ChIJH1zW3_jmaC4RAkvM7An5C5M",
30          "width": 100,
31          "height": 100
32        }
33      ],
34      "place_id": "ChIJH1zW3_jmaC4RAkvM7An5C5M",
35      "plus_code": {
36        "compound_code": "8883+8883",
37        "global_code": "88838883"
38      },
39      "rating": 4.2,
40      "reference": "ChIJH1zW3_jmaC4RAkvM7An5C5M",
41      "scope": "GOOGLE",
42      "types": [
43        "point_of_interest",
44        "establishment"
45      ],
46      "user_ratings_total": 174,
47      "vicinity": "Djuanda Street No.181, Lebak Gede, Bandung City"
48    }
49  ]
50 }
51

```

Figure 4. The response of the following place search request for Bandung City

We made a robot to automate the process of a place search request from executing the API request with certain parameters until eventually writing the JSON output files. Kofax Kapow™ is the Robotic Process Automation (RPA) software that allows users to deploy smart

robots to mimic human actions and automate a wide range of manual, repetitive tasks while driving continuous improvements. Kofax Kapow™ provides a platform to process data from structured or unstructured databases, files, email systems, websites, and portals. It handles automated extraction and transformation of data from Excel, XML, XLS, PDF, RSS feeds and from APIs based on SOAP, REST, XML, and JSON (Kofax, 2018).

For the comparison, we also extract all market directory data from NSO that already published in 2017. The data can easily obtain through its publication on website, www.bps.go.id. The data itself were extracted as Microsoft Excel Files (.xlsx).

Organize

Extracted data from each region that represented on JSON files now will be imported to our database so we can organize all those data in the same place. We use Microsoft SQL Server database, hence we can easily import JSON files into our database through Openrowset function. Openrowset supports bulk operations through a built-in Bulk provider that enables data from a file to be read and returned as a rowset (SQL Server 2017, 2018). We also manage all market directory data from NSO to be imported to the same database as market directory data from Google Maps. The data from NSO were extracted as .xlsx files, we then import all of those data with SQL Server Import and Export Wizard.

Next, cleaning data is applied to prevent duplicate data because there is a high possibility that the market could be registered twice by the similar name, and another possibility that might also come up on other midpoint search result because of the slice of a circle radius. Cleaning data is applied by removing the duplicated data from *name* and *vicinity* variable outputs.

To prevent the place that registered twice, we applied matching from *name* variable. In this process of matching, we make the sequential number of a row within an order from the *name* variable. After that we make use of another Microsoft SQL Server functions, namely Difference sequentially from the row number added from the previous step. Difference functions compare two different Soundex values and returns an integer value. This value measures the degree that the Soundex values match, on a scale of 0 to 4. A value of 0 indicates weak or no similarity between the Soundex values; 4 indicates strongly similar, or even identically matching, Soundex values (Sql Server 2017, 2018). There is no identical match during this process, so we can make sure there is no place being registered twice.

Since the data from Google Maps through Nearby Search are not contains the region information clearly, so we need to dig deeper into its variable output namely *vicinity*. Vicinity contains a feature name of a nearby location, this feature refers to a street or neighborhood

within the given results. From the *vicinity* variable, we analyze and take out its region from every market to be compared with the market data from NSO that already had region information clearly.

Analyze and Decide

Now we have all the clean market directory data both from NSO and Google Maps that also contains the region information. First, we match two sets of data with a similar approach like we did in the cleaning process. We applied matching over *name* and *region* variable. In addition, we also do a manual approach of matching data during this process.

We make use of the Exploratory.io Software to compare and analyze. Exploratory.io is able to map places through *geometry* (long, lat) attribute, so we can make sure the market is in the area of the *region* variable. In terms of ground truth, we can make use of this *geometry* attribute to make a direction to the place. Analyzing from *photos* variable is also applied during this process. To get the information about the active status of the market, we use *permanently closed* variable from Google Maps.

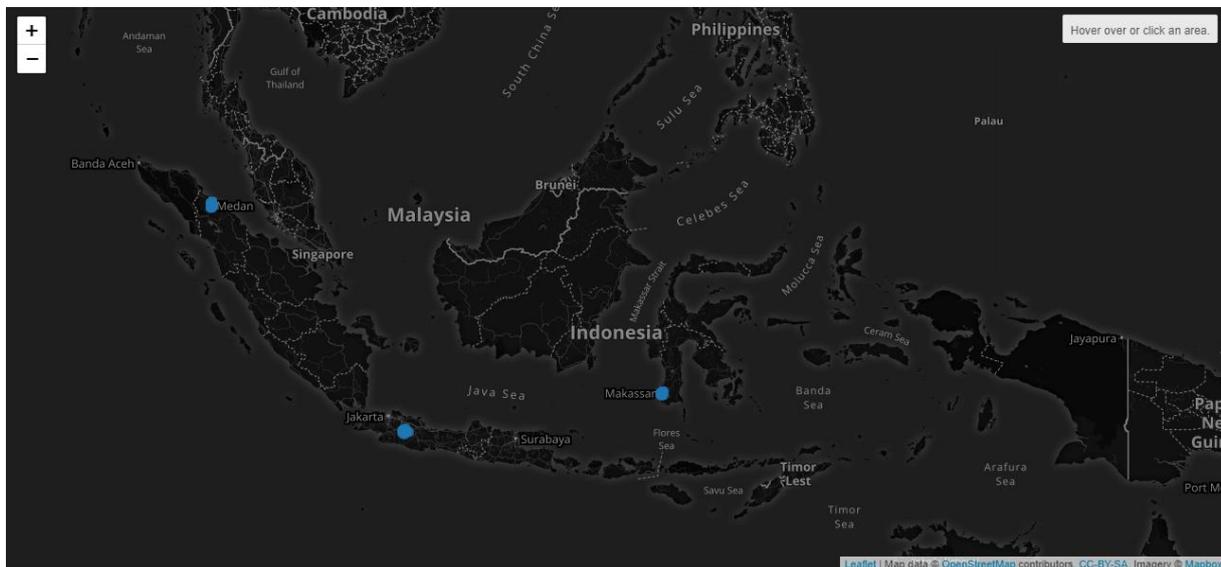


Figure 5. Visualization of Market Directory on Map

Results

In the following process mentioned, we also do the manual approach to get a better result. There are some findings and treatment approached in the following process, shows in Table 2.

Table 2. Findings and Treatment in The Following Process in This Research

Findings	Treatment	Example Case
(1)	(2)	(3)
The names of two or more markets are similar, but each coordinate point is not in one area.	All markets are listed in the market directory, because it is quite common in Indonesia that the name of the market is similar with its main commodity, its operational time, or its type.	<ul style="list-style-type: none"> › Pasar ikan › Pasar bunga › Pasar pagi › Pasar senen › Pasar induk
There are landmarks and places, mostly establishments, have name contained keywords	Deleted from the market directory.	<ul style="list-style-type: none"> › Goro duyung traditional market (swalayan) › Toko telur segar pasar barat › Koperasi simpan pinjam pasar cimahi › Jalan pasar 3
The names of two markets or more are similar and each coordinate point is in one area.	Only one of market names to be listed in the market directory.	<ul style="list-style-type: none"> ● Pasar palapa (Medan) ● Pasar padang bulan (Medan) ● Pasar pendidikan (Medan)
The names of two markets or more are different, but apparently those are the same market	Only one of market names to be listed in the market directory.	<ul style="list-style-type: none"> ● Pasar Mayor - Pulobrayan = Pasar Pulo Brayan/Palapa = Traditional market Brayan (Medan)
There are non-formal markets with fewer than 20 establishments.	Deleted from the market directory.	<ul style="list-style-type: none"> ● Pasar gempol ● Pasar kaget radar ● Pasar tilil

The following diagram shows the results of the matching process of market directory from NSO and from Google Maps in Bandung city. There are 27 markets listed in the market directory from NSO and there are 32 markets resulting from Google Maps market directory. As a result from matching process, 19 markets are matched, which means that those markets are

both listed in market directory and in Google Maps, but 8 markets listed in market directory from NSO are not found in Google Maps. On the other hand, 13 markets from Google Maps are not listed in market directory from NSO. Furthermore, those 13 markets have signpost indicating that those markets have superintendent and are official. According to the guideline from Ministry of Trade of the Republic of Indonesia, every market that has been built must be added with a signpost nameplate with the Ministry of Trade Logo, market name, and the logo of the local government.



Figure 6. Number of Markets Name in Bandung City, Medan City and Makassar City Generated by NSO and Google Maps

From the results, there are still some markets that are not registered in the directory from NSO. We verify some of these markets, whether they are worthy of being called a market

or only mentioned by few and not eligible to be registered as a market. The verification method is done by analyzing from *photos* attributes on Google Maps output, as well as doing the exploration virtually on Street View, by Google Maps. As a result, we remove a number of markets that are not feasible to be called as market mainly because they only contain a group of trader that less than 10 traders and some only occupy the sidewalk of the road. The following is a list of markets that we decided to remove:

Table 3. List of Markets That Are Not Registered in The Directory From NSO

Bandung City	Medan City	Makassar City
(1)	(2)	(3)
Added to the frame	Added to the frame	Added to the frame
<ul style="list-style-type: none"> ● Pasar Kembar Mas ● Pasar Cibogo ● Pasar Cihaurgeulis ● Pasar Cikaso ● Pasar Gegerkalong ● Pasar Sariasih ● Pasar Rancabolang ● Pasar Sadang Serang ● Pasar Leuwi Panjang ● Pasar Kiara Condong ● Pasar Simpang Dago ● Pasar Ancol ● Pasar Ujung Berung 	<ul style="list-style-type: none"> ● Pasar Tani Berseri ● Pasar Cempaka ● Pasar Syahbudin Yatim ● Pasar Pematang Pasir ● Pasar UKA ● Pasar Central ● Pasar Labuhan ● Pasar Pancur Batu ● Pasar Pendidikan ● Pasar Simpang Selayang ● Pasar Sari Rejo ● Pasar Sanjaya ● Pasar Sei Mati ● Pasar Tangkahan ● Pasar ADS 	<ul style="list-style-type: none"> ● Pasar Antang ● Pasar Lama Daya ● Pasar Central ● Pasar Ikan Nusantara ● Pasar Ablam ● Pasar Daya ● Pasar Hertasning Minasa Upa ● Pasar Kalukuang ● Pasar Lette ● Pasar Sukaria ● Pasar Tamamaung Pettarani ● Pasar Tidung ● Pasar Aroeppala ● Pasar Jipang ● Pasar Jongkok
Removed from the frame	Removed from the frame	Removed from the frame
<ul style="list-style-type: none"> ● Pasar Bison ● Pasar Gempol ● Pasar Kaget Radar ● Pasar Tilil ● Pasar Haur Pancuh 	-	<ul style="list-style-type: none"> ● Pasar Panaikang ● Pasar Tello ● Pasar Sultan Alaudin

There is 27.39 percent of the entire markets that is not in the directory from NSO. This is probably due to the method used by NSO which only collects existing directories without conducting a ground checking process to ensure its existence and adding markets that have

not been registered. In addition, we also cannot ensure the list of existing directories is the latest or not.

Conclusion

Big Data as one of the largest data sources can be considered to be used as a complement, even as the main source in creating a market frame. In fact, Google Maps generates most of the markets listed by NSO even though some markets in NSO are not listed in Google Maps, on the contrary, some markets in Google Maps are also not listed in NSO. However, Big Data process could be an effective way to complete existing directories. Big Data could efficiently identify new units to be added to the frame and also possibly removed considering the current market status from Google Maps attribute output and following ground check verification. Ground check verification is required to confirm its existence and also to collect additional data items that might not available from Google Maps, such as the name of organizer, the number of the shop, etc. In conclusion, the combination of these two methods could give the complete frame of market data.

On the other hand, we also need to pay some attention to the license on Google Maps on scaling this process up. Google Maps APIs for Work customers are provided with higher usage limits for the Google Maps Platform web services than those for free API users. Google Maps contains reviewed content from various sources and may have errors. Also, we can not ensure that some remote locations data may be fully available on Google Maps. However, this process could be a cost-effective way to update the frame without conducting the whole ground process.

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