

GEOSPATIAL ANALYSIS AND BUSINESS INTELLIGENCE IN MASSAGE AND SPA CENTER

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ABSTRACT. *The implementation of Business Intelligence (BI) has grown rapidly today. However, most organizations are struggling in the BI design, development, and result interpreting. This study has two research objectives: 1) to demonstrate the BI design and development for massage and spa center, and 2) to illustrate the result interpreting related to geospatial data in massage and spa context. The research methodology has three stages: 1) understanding of business requirement, 2) design and development, and 3) BI testing. The user's checklist was a research instrument to evaluate users' requirements after their BI-HC training and tryout. In the results and discussions, the study presented and discussed the results of BI-HC development, user's checklist, and data analysis. The analyzed findings indicated the unbalanced allocation of staff's tasks and distribution of patients. Additionally, the analyzed results revealed the amount of treatment rights of patients in terms of locations and service types. These findings can help the head of Hatyai Chivasuk to make decision and plan organization's strategy in terms of staff allocation, manpower, and service activities.*

Keywords: Business intelligence, Dashboard, Geospatial analysis, Massage, Spa

1. **Introduction.** Most businesses use geography to analyze in their tasks increasingly because it is easy to generate map today. There are many tools to create geospatial analysis such as Microsoft Power BI, ArcGIS, Looker Studio, and Tableau. Furthermore, the geographical outputs can be easily and quickly communicated with readers by symbols and colors. Additionally, the map can present the quantitative data in graphical format, for example, spread of COVID-19 in each country, various kinds of physical engagements on density dispersion of participants [1], and level of flood damages in each state [2]. Hatyai Chivasuk is the organization of traditional massage and spa service center in Songkhla, Thailand. This organization provides the Thai traditional massage and spa therapy for customers and patients. In addition, Hatyai Chivasuk has many healthy activities such as social dance, aerobic swimming, healthy consults, weight-controlled courses, healthy cooking, and herb drinking. However, there are some limitations in terms of the staffs in massage and spa services. Therefore, manager and staffs need the geospatial analysis to properly organize activities and manpower operations for their patients in each area, for example, the service plan must not provide any staff in district which is no number of patients, and send staffs to carry out activity services based on patient's proportion

in each city. However, their report processing is manual system today. They cannot report data in real time. Therefore, it is necessary to develop reporting tools for supporting staffs. Accordingly, the geospatial analysis and BI were brought to develop tools, namely Business Intelligence of Hatyai Chivasuk (BI-HC). The objective of this study aims to illustrate the BI-HC in terms of design and development based on geospatial analysis and business intelligence concepts, and analyze the message data for supporting business requirements.

2. Literature Review.

2.1. Geospatial analysis. Geospatial analysis is the process of creating new information about a set of geographic data to perform useful evaluation, routine examination, assessment, and analysis in a geographic area. For example, emergency management, flood extension areas, retail analysis, transportation modeling, business location, crime and disease mapping, and natural resource management. Geospatial analysis is an appropriate method for geometical presentation, estimating, predicting, interpreting and understanding. The results of geospatial analysis can be presented with a variety of graphic symbols as labels to represent data. The different colors usually are used to enhance interpretability in terms of states, cities, countries, and areas [2]. For compared results, the different shades are used to communicate in map [3]. In addition, the map with different sizes of bubbles or bubble map chart is commonly used to represent the different values and geographical distribution [4]. Therefore, most previous studies applied the geospatial analysis in their works, when they presented the distributions [4] and geography comparisons [3]. In this study, the staffs need to analyze patient's distribution and geography comparison; thus, the geospatial analysis was applied in BI-HC.

2.2. Business Intelligence (BI). BI is defined as a set of visuals that includes historical information and real-time data that are gathered from different source systems and file formats. Three main processes of data preparation in BI were described as the following.

2.2.1. Extraction. The process pulls data from different sources and formats. The common data source formats include .pdf, .xlsx, .csv, .json, and .xml. In addition, BI can extract data from several sources such as website, SQL server, ODBC, cloud, and database.

2.2.2. Transformation. The process provides rules to meet business's requirements and reporting. The examples of sub-processes are to clean inconsistency data and missing values, remove duplicated data, improve data integrity, translate coding values, join data from multiple sources, split columns, sort values, and calculate values.

2.2.3. Load. The process loads the transformed data into a new destination such as data lake, data storage, data repository, and data warehouse. There are two types of loading. First, full loading is loaded all data at once. This approach is expensive and difficult to maintain. Second, incremental loading is the approach to comparing incoming data with existing data, and only produces additional data. In this approach, the data warehouse is less expensive, and data is easy to manage for BI system.

Business users can use BI dashboard to support their strategic and tactical decision-making easier. BI provides interactive data, charts, graphs, and maps, that helps them to understand the current and historical situations [5]. In addition, drill-down and drill-up are the special features of BI. Users can view the deeper or lower insight level without jumping to another chart or report immediately, namely drill-down feature [6]. In addition, BI users can use the drill-through feature to see the related data [7]. For example, a tabular report that shows sales revenue by city which can allow the user to click on it and reveal a sales revenue by the other dimension, or a heat map representing the data in visual form. The BI system allowed to plot and compare data from different locations [8]. The related studies

[9-12] suggested that BI development should focus on easy data extraction, and sharing specific insights. Several previous works in healthcare context succeed in improving their tasks by BI system, for example, business analysis [7,8], monitoring [10], and decision making [8,9]. According to [13], the user involvement was the factor of implementation success. Therefore, this study developed BI-HC to improve the staff’s tasks with user involvement.

3. **Research Methodology.** This research had three processes as illustrated in Figure 1: 1) Business understanding, 2) BI design and development, and 3) BI testing.

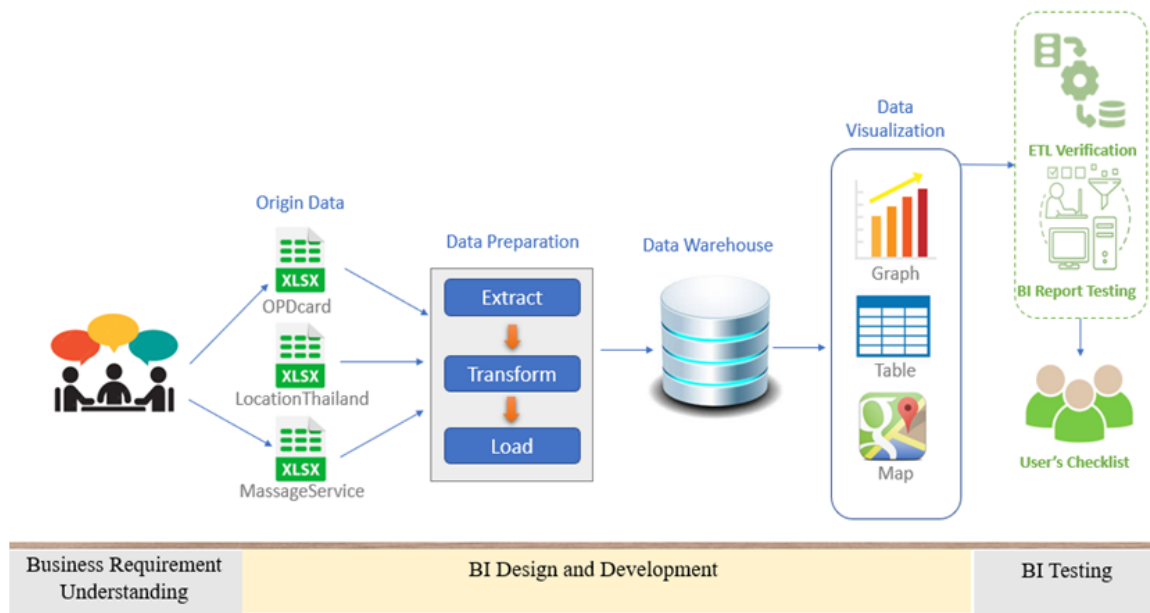


FIGURE 1. Research processes

3.1. **Business understanding.** Hatyai Chivasuk provided the massage and spa services for patient at Hatyai city of Songkhla in Thailand. The Hatyai Chivasuk needs their data to generate the useful information in terms of 1) Staff’s service; 2) Distribution of patients; 3) Amount of service in each treatment right; 4) Amount of service in each service type; 5) Monthly filters to see information in terms of patient’s distribution, service amount, service hours, staff workload, and number of treatment rights.

3.2. **BI design and development.**

3.2.1. *Original data.* This study used three source files as the following: 1) “OPDcard.xlsx” was the list of patient details (1,472 rows) that data exported file from the Java Health Center Information System (JHCIS). The JHCIS is the centralized system in healthcare of Ministry of Public Health (MOPH), 2) “LocationThailand.xlsx” was the latitude and longitude in each district of Thailand (7,425 rows), and 3) “MessageService.xlsx” was the transaction file of massage services (2,651 rows) that data exported file from the JHCIS.

3.2.2. *Dimensional data model design.* In this process, the study focused on the plan of a multidimensional model as presented in Figure 3. There were five dimensional tables and one fact table. The fact table was the transaction of massage services. Five dimensional tables were presented as follows: 1) DIM_Right was collected of the types of treatment rights such as government official, retired person, disability rights, and rights of social security; 2) DIM_Date was the dimension of date that was the continuous data between 1/1/2565 and 31/12/2565 (B.E); 3) DIM_Location was contained of the latitude and longitude in each district of Thailand; 4) DIM_MessageType was collected of the type of

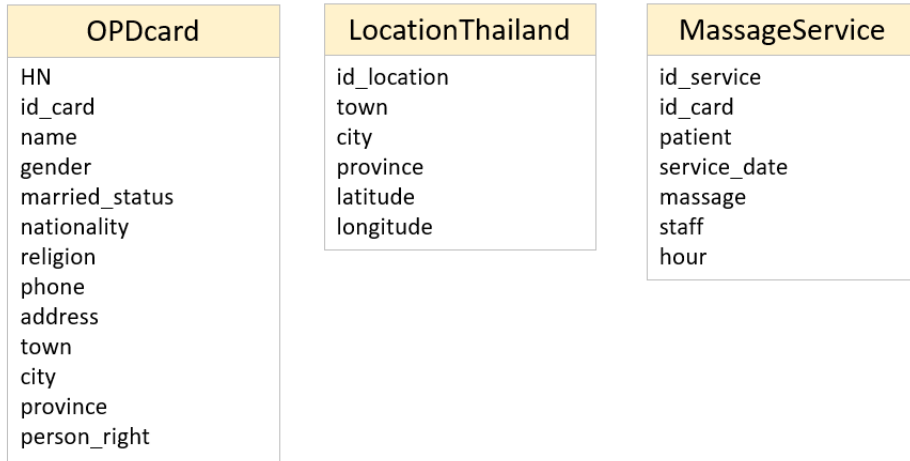


FIGURE 2. Original data

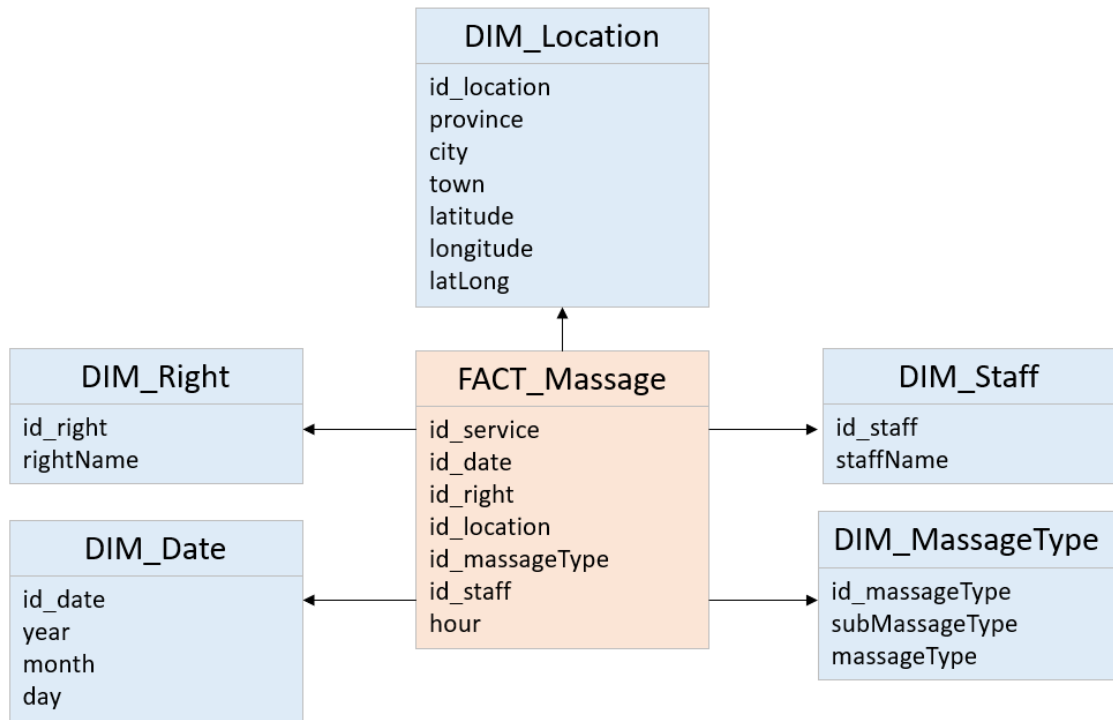


FIGURE 3. Data model of BI-HC

message service that the Chivasuk provided for their patients such as Thai massage, Thai herbal compression, and Thai herbal streaming; 5) DIM_Staff was collected of the list of Chivasuk’s staffs.

3.2.3. *Extract, Transform, Load (ETL)*. BI typically uses the Extract, Transform, and Load (ETL) method to aggregate structured and unstructured data from multiple sources, and load to the data warehouse. In this study, six ETL processes are illustrated as follows.

- *DIM_Location*: In ETL of Thai location dimension, the LocationThailand.xlsx was retrieved. After that, the latLong column was created to collect both latitude and longitude in each district. Finally, the location data was loaded to DIM_Location in data warehouse.

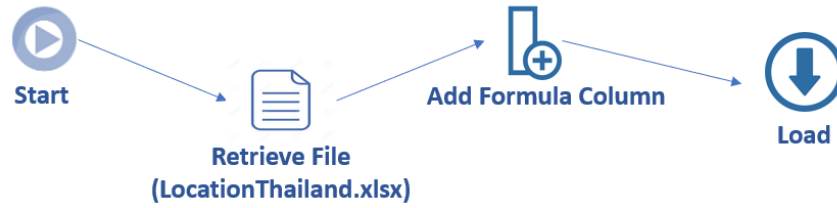


FIGURE 4. ETL process of DIM_Location

- *DIM_Right*: To create the dimensional table of treatment right, the OPDcard.xlsx was retrieved, and then removed all columns except person_right. Next, the duplicated rows were removed, and then the person_right column was renamed to “right-Name”. After that, the id_right column was added as the indexed column of this dimension. Finally, the data of this dimension were loaded to DIM_Right table.

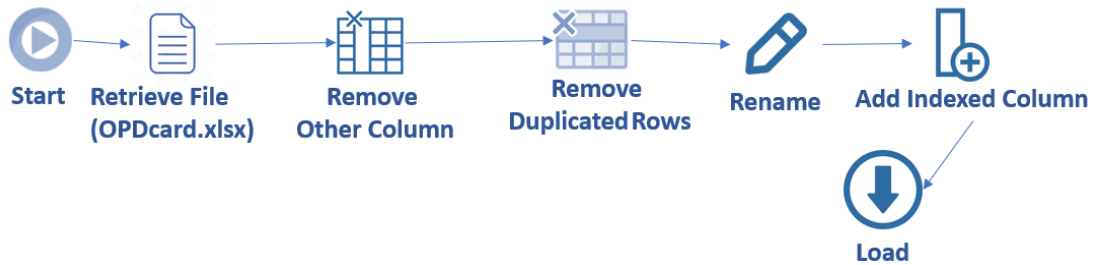


FIGURE 5. ETL process of DIM_Right

- *DIM_Date*: To create the table of date dimension, the calendarauto() was run, and then the generated column was renamed to “id_date”. Next, the id_date was split to new columns as day, month, and year. Finally, the data of this dimension were loaded to DIM_Date table.

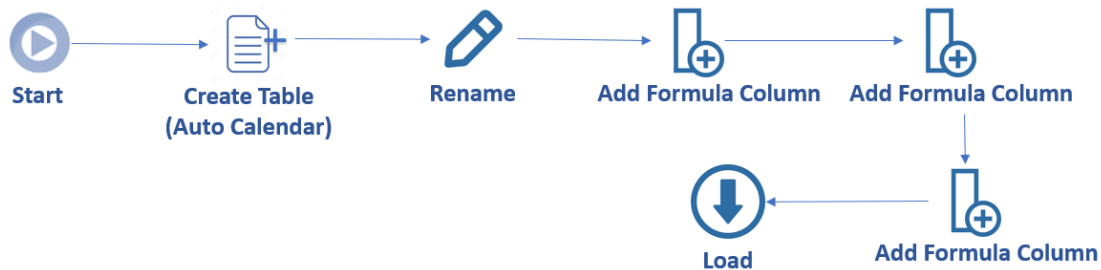


FIGURE 6. ETL process of DIM_Date

- *DIM_MessageType*: To create the dimensional table of service types, the MessageService.xlsx was retrieved in the first step. Second, all columns were removed from this table except message column. Third, the duplicated rows were removed, and then the message column was renamed to “subMessageType”. Next, the id_messageType column was added as the indexed column of this dimension. After that, the messageType column was added from the example text. Finally, the data of this dimension were loaded to data warehouse.
- *DIM_Staff*: To create the dimensional table of staff, the MessageService.xlsx was retrieved in the first step, and then removed all columns except staff column. Next, the duplicated rows were removed, and then the staff column was renamed to “staffName”. After that, the id_staff column was added as the indexed column of this dimension. Finally, the data of this dimension were loaded to DIM_Staff table.

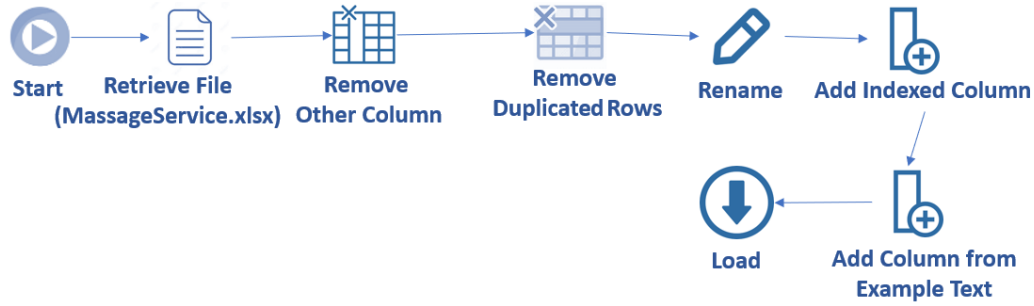


FIGURE 7. ETL process of DIM_MessageType

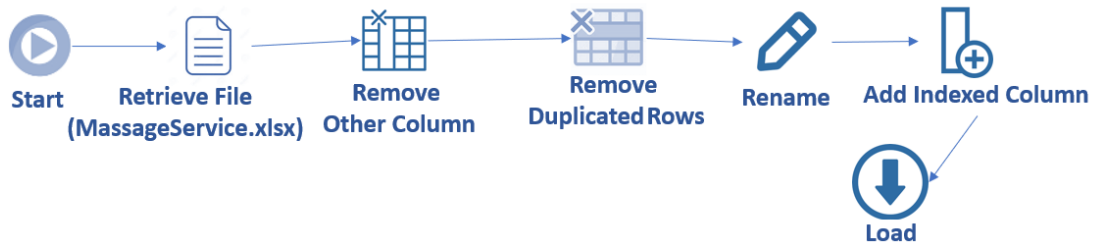


FIGURE 8. ETL process of DIM_Staff

- FACT_Message*: To prepare fact table, the origin files (OPDcard.xlsx and MessageService.xlsx) were joined to dimension tables (DIM_Location, DIM_Staff, DIM_Right, and DIM_MessageType) as presented in Figure 9. After joining process between two tables, the required columns were selected for providing FACT_Message table. Finally, some rows were removed when id_service was blank, and then all data were loaded to FACT_Message table.

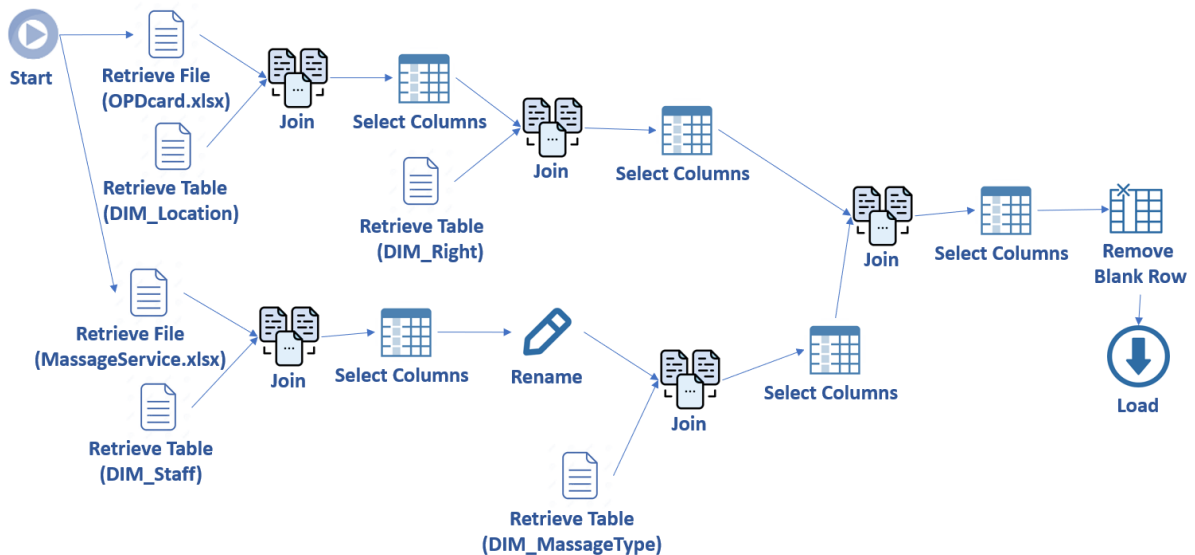


FIGURE 9. ETL process of FACT_Message

3.2.4. *Data visualization.* To develop the data visualization, the Microsoft Power BI was used to create dashboard, namely BI-HC. The BI-HC was provided five dimensions for users to interactions such as date, staff, service type, treatment right, and location. Users can drill-down and drill-through to get more details. In addition, users can filter data by selecting a part in each visual, and then the other visuals will be automatically presented based on their filter data in different dimensions.

3.3. **BI Testing.** BI Testing is the process to guarantee information creditability and right execution; thus, BI-HC system was tested by developers as follows.

3.3.1. *ETL verification.* In this testing process, the generic test cases needed to be verified in terms of extraction, transformation, and load. For example, verify data was mapped correctly from source to target system, verify that null fields were not populated, automatically updated a record when value columns were changed in refreshing time, verify data type and format in the target system, and verify there was no duplicate data in target system. In this study, the ETL processes were automatically refreshed every hour between 9.00 am and 5.00 pm.

3.3.2. *BI report testing.* To report testing, the test cases in many scenarios were done to confirm the report requirements and design specifications. For example, dashboard page title corresponded to the content of reports, data filter in reports should be presented of the accurate outputs, and level of data in the reports should be appropriate based on report requirements.

4. **Results and Discussions.** The BI-HC dashboard consisted of home page and five dimensional pages. The home page was provided of the overview information in each dimension as presented in Figure 10, for example, staffs, service types, patient’s distribution, service date, and treatment rights. In this study, patient’s distribution was illustrated in bubble map of BI-HC. The patient of Hatyai Chivasuk came from every part of Thailand. However, the biggest bubble is Songkhla, indicating most patients are living in South of Thailand. The Map can drill down from state level to city and district level. The donut chart of service type can drill down to sub-type of services.

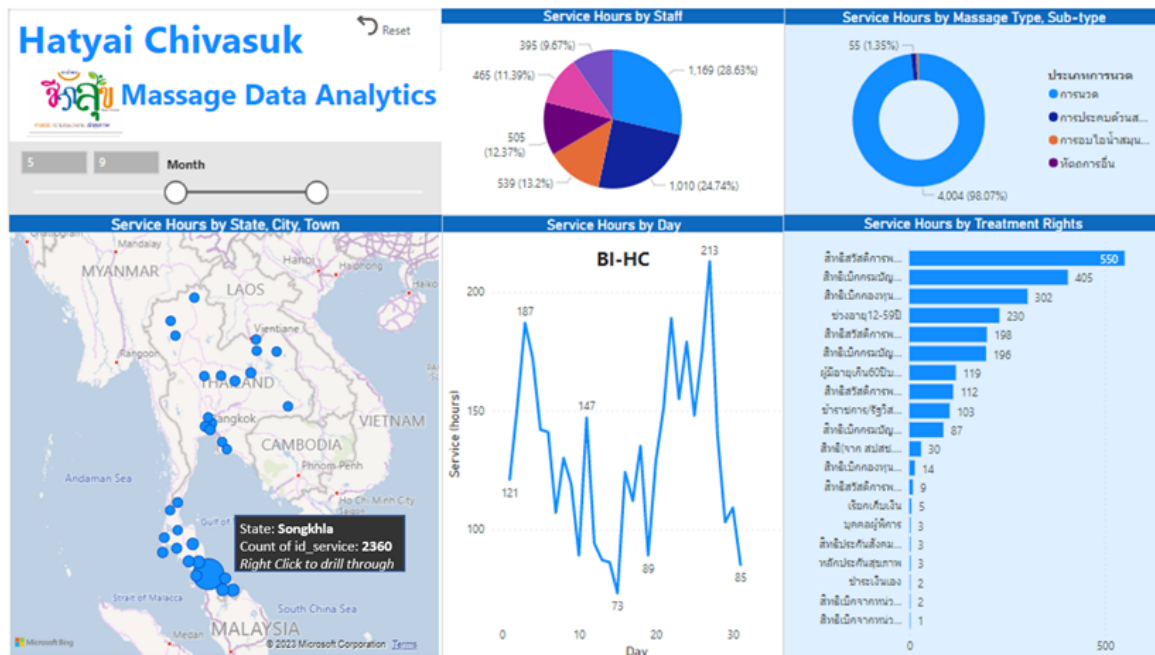


FIGURE 10. Homepage of BI-HC dashboard

In addition, every chart in BI-HC homepage can drill through the deep details in each dimension as the example in Figure 11.

Furthermore, the shape map of city in location page presented the patient’s distribution in city level as shown in Figure 12 (left). Users can move mouse over the city and then the tooltips showed the summary of hour services. Additionally, they can drill-down to see the selecting city in district level as presented in Figure 12 (right). For these shape maps,

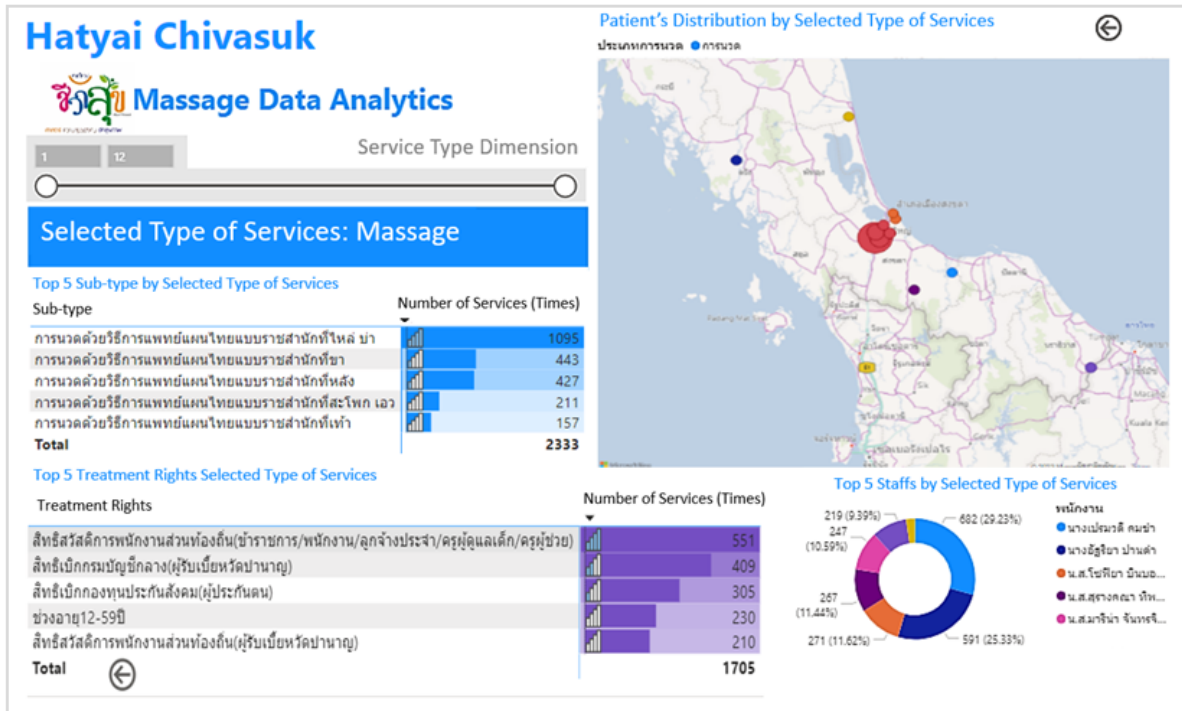


FIGURE 11. Dashboard of service type by drill-through from homepage dashboard

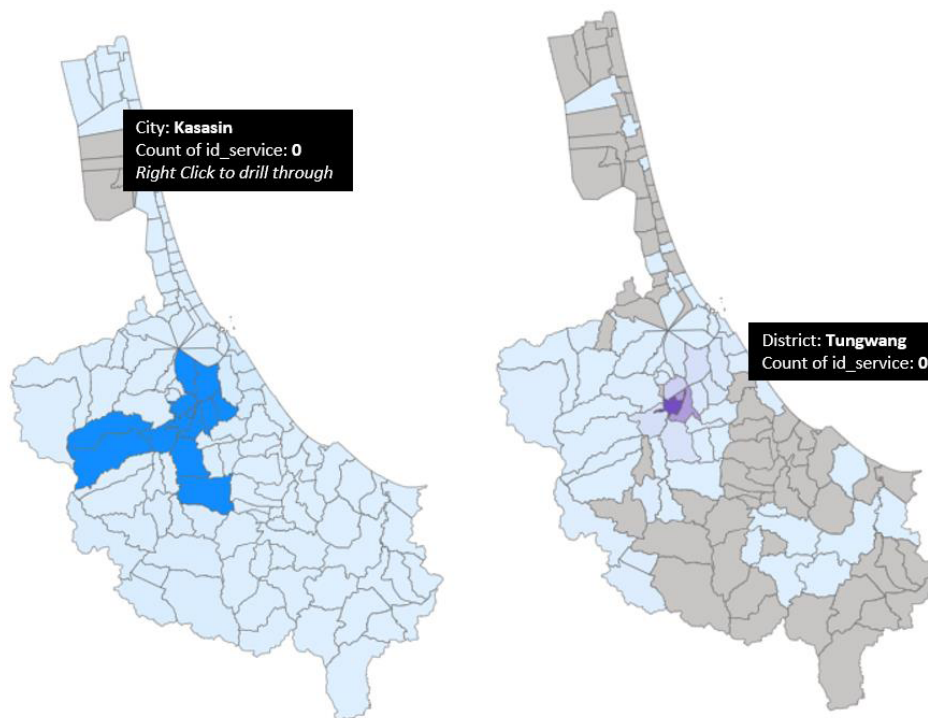


FIGURE 12. Shape map of city (left) and district (right)

users can make decision to plan the service activities in terms of city and district levels. For example, Kasasin city (gray color in the left map) and Tungwang district (gray color in the right map) did not have any patient’s Hatyai Chivasuk, and then staffs should not go to this area to serve their patients.

The BI-HC checklist was sent to all related users in three roles: a head of Hatyai Chivasuk, a massage chief of Hatyai Chivasuk, and ten related staff in massage and spa.

The examples of key indicators in BI-HC checklist were presented in Table 1 based on business requirements, dashboard design, filter check, page navigation, matching between summary and detail report, and accuracy of drill-down and drill-through. The suggestions from the user's checklists were used to improve BI-HC system, for example, user noted that the y-axis of bar chart should be larger font size in staff page, and then the font size at y-axis of bar chart is increased in staff page.

TABLE 1. Examples of key indicators in BI-HC checklist

No.	Checking issue	Pass	Note
1	BI-HC dashboard can support your business	/	-
2	Staff page presents the sufficient information for your business	/	-
3	The page of treatment right presents the sufficient information for your business	/	-
4	The page of service type presents the sufficient information for your business	/	-
5	Location page presents the sufficient information for your business	/	-
6	After month selecting, all visuals in BI-HC dashboard present information in your selecting month	/	-
7	Each page identifies the correct title	/	-
8	Axis in charts are labelled appropriately	X	larger size
9	The drill-down of bubble map in BI-HC dashboard to upper and lower level is correct	/	-
10	The drill-through to staff page is correct navigation	/	-

Several challenges occurred in BI-HC design and development. First, BI is newly for staff's Hatyai Chivasuk and then they did not have skills in this technology. Accordingly, they cannot explain their requirements and desired outputs in a few times of interview. To achieve user's satisfaction and requirement gathering, we increased the user involvement [13]. Thus, BI developer in this study developed the several versions of mockup and discussed with them during design process. Second, we did not have permission to connect JHCIS's database directly, hence it is necessary to export data from JHCIS via manual system into the preparing folder first, and next the ETL process can run automatically by our refresh-time setting every hour. The other BI developers can use this approach to solve the similar problem in their BI development.

For data analysis, the findings contributed to understanding the massage services and spa of Hatyai Chivasuk. There were several insights in multidimensional aspects: 1) There was the unbalance allocation in staff's workload as a result of staff's massage skills. Therefore, Hatyai Chivasuk should train the staffs in particular of Thai traditional massage on shoulders, legs, and back because these sub-types of service were demanded by patients highly; 2) For location aspect, the different shades of shape map enhanced interpretability in terms of cities and districts [2,3]. There was only one city in Songkla without any patient of Hatyai Chivasuk, namely Kasaesin. The bubble map clearly revealed the geographical distribution of patients likes the study of [7]; 3) The top of service types was Thai traditional massage, while the other types (e.g., herbal compressing, herbal streaming, and the other operations) were a little number of services; and 4) Most patients used their government welfare (92.5%) while only 7.5% paid the massage services via cash.

5. Conclusions. Overall, this study can demonstrate the design and development of BI-HC system based on geospatial analysis and BI concepts. The user's checklist showed that the BI-HC met the business requirements as well among three user roles. The suggestions

in user's checklist can help BI developers to improve the performance of BI system. As future work, we will collect the user's satisfaction by survey questionnaire among all staff related to massage services after receiving the certificate of Human Research Ethics from PSU-HREC. In addition, the future study will extend the other services in healthcare context such as drum therapy.

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