

Data Warehouse System to Support Condition Health Care of Elderly

Rattanawadee Panthong

Department of Information Technology, School of Information and Communication Technology, University of Phayao, Thailand

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Email: rattanawadee.pa@up.ac.th

Abstract: Maeka Health Promotion Hospital conducts a survey on health conditions and collects the data involving activities or organization operations each year, particularly, the data on the elderly health care having too much. This might lead to difficulties in searching and analyzing the information. To solve this problem, it is essential to rely on tools and information technology in making a decision of the administrator rapidly and correctly as well as being the information for caring for and rehabilitating the elderly's health. The objectives of this study are to develop the data warehouse system and to create data visualization to depict the online report in the form of a dashboard. The research results indicate that the data warehouse system in supporting the elderly's health care consists of four reports such as the report on the elderly's score Activity of Daily Living (ADL), the statistical report on the elderly's living, the reports on the elderly's behavior, ailment and physical disabled and the statistical report on the elderly's health problem and the depression condition evaluation. Meanwhile, the user's satisfaction with the data warehouse system is at a good level ($\bar{x} = 4.21$, S.D. = .008).

Keywords: Data Warehouse, Business Intelligence, Activities of Daily Living, Elderly, Health Care

Introduction

Currently, information and digital technology are rapidly developing and play an important role in business operations. Thus, organizations should adapt their working process and model. The administrator's decision is important for adapting the administrative strategy which is adjusted in accordance with the situation and the business drive leading to fulfilling the target. In determining the strategy, it needs to use the data from several sections. However, is the only data in the stage of operation which have limitations, for example, it lacks flexibility in supporting the decision making and some submitted data to the administrator must be the concluded data in order to be used in making a decision.

The creation of the information technology system aims to support the decision-making or prepare the data for strategy. The design of a data warehouse focuses on classifying the information data from the general data. The main reasons for developing the data warehouse are to connect the general operation from different sources to only one source and to have the architecture supporting the analysis in order to make a decision in the organization to replace the old system that is used in operation.

Maeka Health Promotion Hospital has a health condition survey and collects data involving the office's activities or operations every year, in particular, the data on the elderly's health care has a large number of data that are difficult to search and analyze. Hence, tools and information technology are needed to collect the big data and help analyze the data in order to support the administrator's decision-making rapidly and correctly to get the important data for the operation of elderly health care.

Thus, this study has an idea to develop a data warehouse system to support the condition of health care of the elderly and to enhance the administrator's decision-making by designing the dimension data warehouse in the form of dimension data. The data are analyzed to make the correlation in accordance with the needs of the administrators in the form of OLAP: Online Analytical Processing and data visualization depicting the online report in the form of a dashboard.

Background and Related Work

Activities of Daily Living (ADL)

The activities of daily living consist of the assessment of the elderly's health condition, the ability to do their daily life, and Barthel activities of daily living: ADL. The

elderly health condition is assessed in three aspects; mental, physical, and social as well as the ability of doing their function. The data obtained from a survey on health conditions will be taken to plan the elderly health care and follow the changes and the health care results. Thus, the assessment of the elderly's health care needs to be continuously evaluated every year (Collin *et al.*, 1988). The ten activities of the Barthel Index assessing ADLs are as follows: feeding, bathing, grooming, dressing, bowel, bladder, toilet use, transfers bed-to-chair-and-back, mobility on level surfaces, and stair negotiation (Beltz *et al.*, 2020).

Data Warehouse

A data warehouse is a big database that can gather the big data in one place from different sources both coming from inside or outside the organization (Gupta and Singh, 2014; Farooqui and Mehra, 2018). The data warehouse is primarily designed to analyze (Bahaa *et al.*, 2021). This data warehouse is the only reading database that collects the data in order to analyze decision-making (Nambiar and Mundra, 2022; Hosmane and Rakshitha, 2021). The components of the data warehouse are illustrated in Fig. (1).

Features of Data in the Data Warehouse are as Follows

Subject-oriented oriented-the data is collected and created from the subject which is interesting or involving with business operation. The created data comprises the subject with specific and necessary news for only the business decision-making process. This is done by the data kept and classified according to its group which will help the business to follow its results rapidly leading to knowing the business operation result quickly. For example, if the company wants to use the data warehouse, the database is created from the client's history, insurance payment, and claiming instead of classifying according to the product type or life insurance service (Singh and Ghate, 2017).

Integrated data will be gathered from different sources to create the data warehouse or from different applications, operation systems, data forms, and different platforms. It must be done via the data warehouse system collecting the data from different sources changing it into consistent forms and creating a consistent database, for example, the value of one variable in each database will be different which means that one database may use 0 and 1 and another may use T and F. Thus, the new database will determine the value of the variable to be the same as one or the same form Singh and Ghate, 2017).

Time-variant data warehouse system will maintain the data to predict, compare, and make a decision. The decision-making data must be 5-10 years old in order to be applied for comparing the trends and predicting the future results Singh and Ghate, 2017).

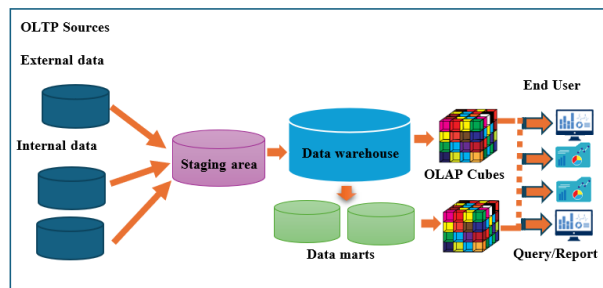


Fig. 1: The component of the data warehouse

Non-volatile the data can't be easily updated or changed so the user of the database warehouse can only load and access the data because the objectives of the data warehouse are to read the data or see the data and use the data in analyzing for the decision-making only Singh and Ghate, 2017).

Online Analytical Processing (OLAP)

The data from the data warehouse is used to analyze the possibility of the future by using a multidimensional database (Nawaz *et al.*, 2020). OLAP is the technology using the data from the data warehouse which is used to analyze and decide effectively in business and can find the answer needed and being one of business intelligent tools. It helps make a decision by analyzing multidimensional data, and conclusive data, and able to see several dimensions which are easily used for the information of decision making (Guarani *et al.*, 2019; Wang, 2011).

Business Intelligence (BI)

Business Intelligence (BI) is the technology that has the capacity to change the normal data into the in-depth data which can help the business access the analysis and develop the in-depth data gained to help the business make a decision more intelligent via passing the data movement. The advantage of the BI system can show the needed result and the result is accurate which can be used to be the data to help make a decision more rapidly. Furthermore, this system is easy to use (Minh *et al.*, 2022; Yulianto and Kasahara, 2018). The business dimensional analysis is to analyze the data brought to create the data warehouse which asks about the understanding and the details on business operations, the measure of the important and essential success to the business, and the source of data which is needed to be applied for decision-making through a questionnaire or an interview from the users from each department of the company including interviewing the administrators of each department about the needs and the concepts of running the business (Guarani *et al.*, 2019; Aguilar-Savén, 2004).

Data Visualization

Data visualization is to bring the data received from

different data sources to be analyzed and processed and then presented in an easy way such as a chart, picture, map, table, video, and dashboard (Minh *et al.*, 2022). The dashboard is used to conclude the data in an executive form with different perspective views leading to seeing easily, answering less time consumption in interpreting, and being able to answer the business questions. Moreover, it is used to follow interesting things in order to see the changes all the time by bringing different data to be concluded so as to see the picture on one page and regularly updated data (Yulianto and Kasahara, 2018, Arora and Chakrabarti, 2013). The benefits of data visualization are as follows:

- Pictures and colors can be easily told and give better feelings than words or numbers
- It helps understand the data easier because it is small data and can be understood via pictures
- It helps see insight, advantages, and trends of data. This will help reduce the data correlation more easily
- It helps save time in interpreting the data and making a decision, understanding the data without interpreting, reducing searching load, and comparing data
- It helps to see the interesting point of data in spite of proving the hypothesis about the data and be able to see the data having some distinctions from understanding the picture
- It helps the data be more interesting from story presentation or using several colors

Related Work

Other researchers have presented data warehouse and business intelligence systems. Togatorop *et al.* (2022) propose a method of the dimensional model to create a data warehouse from Twitter and use lexicon-based. The aim of this study is to analyze the public opinion of Twitter users toward covid-19 vaccine in Indonesia. The results of this research indicate that the building data warehouse and business intelligence have been successfully carried out based on the evaluation of sentiment analysis when the Kimball model approach is applied. The output gained the accuracy of sentiment analysis is 74%.

The data warehouse method and analytic business intelligence based on the Bedstead manufacturer's ERP system are presented by Gaol *et al.* (2023). The aim of the research is to create a blueprint of the data warehouse and analytics and business intelligence. The blueprints are used to support the company's vision and goal. This research is applied to the business model, the system model, the technology model, the sub-contractor, and the function enterprise for planning based on Zachman's framework.

Duarte *et al.* (2023) propose the Electronic Health Record (EHR) method with business intelligence in information healthcare systems. This approach is used to

evaluate healthcare institutions and to improve decision-making. The output of this study demonstrates that OpenEHR with BI provides for better communication during giving services and consequently.

Akbar *et al.* (2020) propose a method of creating a business intelligence application for the XYZ Store using Interactive Dashboard Visualization. The Pentaho Data Integration (PDI) is applied in the design ETL step. Public Tableau is used to generate a dashboard and graphic visualization in the XYZ store. The benefits of this research can help produce reports in interactive dashboard visualization and make better decisions for store managers.

Pipatjessadakul and Pinngern (2019) propose a method of business intelligence system to support electrical distribution. The reports are created using Tableau on the web application. The BI system consists of 3 reports namely, the power distribution unit report, the outstanding electricity bill report, and the statistical report. The output of the research indicates that the business intelligence system gains the users' satisfaction at a good level.

Ghosh *et al.* (2015) present an approach to building a data warehouse in business intelligence. In this article, they integrate data warehouse architecture to improve and design business intelligence. The business intelligence in the data warehouse is applied to generate reporting, knowledge generation, query processing, and data center management. This distributed architecture provides knowledge and corresponding business intelligence both locally and globally.

Kocakoç and Erdem (2010) present the creation of business intelligence for a retail business company. The purpose is to apply business intelligence using Microsoft SQL Server. This research is focused on a textile company. The results from this article showed that reports can predict and make strategic decisions for the manager team.

Ali *et al.* (2016) use BI applications for improving the process of hip fracture care. In this article, they integrate data warehouse architecture to improve and design business. The SQL server management studio is applied to generate data warehouse and Excel 2010 is used to create the pivot reports. The results indicate that the BI system can help improve and integrate regional rehabilitation systems for patients with hip fractures.

Materials and Methods

Proposed Methods

In this study, the researcher presents the method of the data warehouse system to support the condition of health care of the elderly, which is shown in the research conceptual framework as in Fig. (2). The process of the proposed method contains four steps:

1. To study the related literature and then to analyze it. In the analyzing stage, data is collected from the users

and other sources. The data gained is taken to design the data warehouse

- To create the data warehouse and prepare the database through Microsoft SQL Server. The data warehouse will keep the dimensional data and be able to choose to see from different perspectives in order to be ready for analyzing and presenting the reporting data. The star schema model is used for designing data warehousing and business intelligence as in Fig. (3)

In this step, the data preprocessing before the ETL process is as follows:

- The attributes are discretized by claiming the values
- from the laboratory and determined by the expert
- The substitution technique of missing data is used with the unknown value

- The process of bringing the data into the data warehouse is the process of choosing the data and loading the data into the data warehouse by ETL process. ETL process includes three steps: The extraction process is used to pull data from various sources including the ADL database and Excel file. Then, data cleaning is the process of validating and modifying data before transforming the data phase into the desired format. The next step, data transformation is to convert, extract, and map the data into a usable format. In the final step, the data is loaded into the target data warehouse. These phases are done by Microsoft SQL Server Integration Services via Microsoft SQL server data tools.
- The creation of an online analytical process report (OLAP) is done by Microsoft Power BI Desktop. Then, the users will process the dashboard model and publish it online via Power BI services (Gonçalves *et al.*, 2023). The presentation of dashboard reports and sign-in via the internet browser web

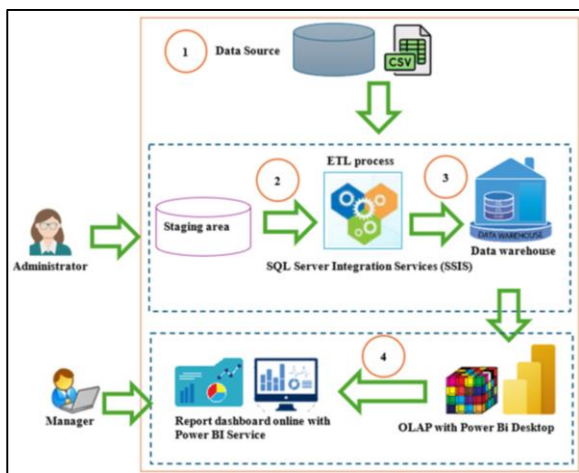


Fig. 2:The framework of the data warehouse system to support the condition health care of the elderly

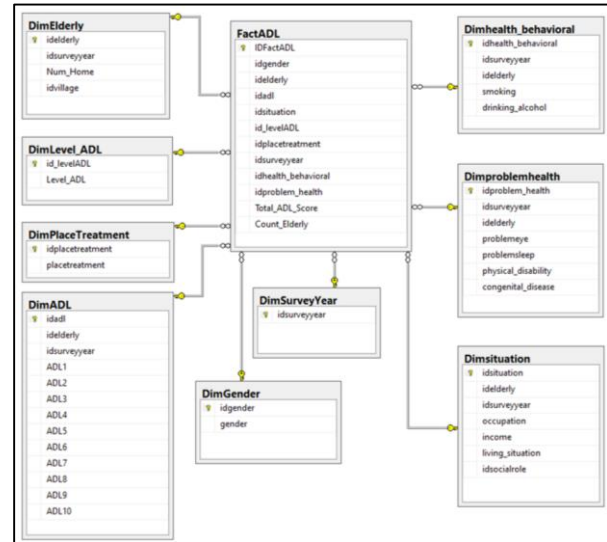


Fig. 3: Star schema model

Purposive Sampling

The samples are randomized through purposive sampling (Nyimbili and Nyimbili, 2024). The characteristics of the selected groups were in accordance with the research objectives. The target population of this study consists of 20 samples who are hospital administrators, Registered Nurses (RN), general staff, and chairpersons of the village public health volunteers who have knowledge and experience in ADL report data for at least two years.

Statistical Methods for Research

Statistical methods used in research consist of the average and the standard deviation. The evaluation form of satisfaction, a five-rating scale, and a reliable value of 0.88 (Prabhaker *et al.*, 2019). The results are compared with the evaluation criteria as follows”

- The average value is equal to 4.50-5.00, meaning that the highest level
- The average value is equal to 3.50-4.49, meaning that it is at a high level
- The average value is equal to 2.50-3.49, meaning that it is at a moderate level
- The average value is equal to 1.50-2.49, meaning it is at a low level
- The average value is equal to 1.00-1.49, meaning the lowest level

Results

The Results of the Development of a Business Intelligence System

The development of the business intelligence system

by presenting the dashboard online report which can choose the dimensions as the user needs. Moreover, this technique is able to show the report data in the form of a data table or chart. Power BI desktop program is used to create dashboard reports. The dashboard report can make the user analyze the data and compare the data leading to seeing the differences clearly and is able to bring the data to help support the decision-making more rapidly and accurately. The login and the main system are shown in Figs. (4-5).

The statistical report on the elderly's living is classified according to the village, role in society, and living situation. Moreover, both pie graphs show the proportion of the number of elderly according to their occupation and income. Thus, the user can screen the data according to the year surveyed, gender, and ADL level as shown in Fig. (6).

The report on the elderly's score ADL is classified by year and the ADL level. The elderly's score of ADL is compared with ADL level between 2022 and 2024. The total score of ADL of the elderly compares between 2022 and 2024 by classifying according to yearly period. Moreover, the user can choose the data according to the year surveyed. The total score of ADL, the ADL level, and the total number of elderly are shown in Fig. (7).

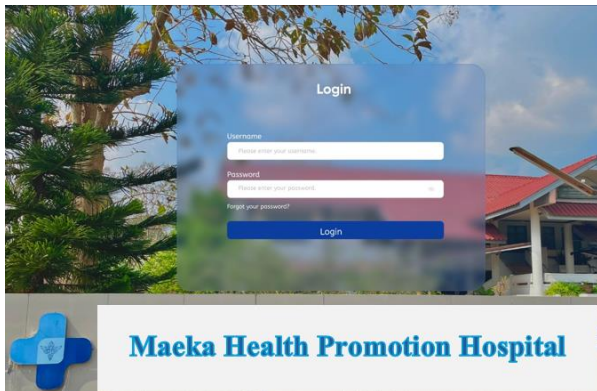


Fig. 4: Login system



Fig. 5: Main menu of the system

The statistical reports on the elderly's behavior, congenital disease, and the physically disabled are classified according to the place they are treated. The users can choose the data according to the surveyed year, village, and ADL level as shown in Fig. (8).

The report on the evaluation of the elderly's depression condition who are disappointed, frustrated, and hopeless is classified according to the survey year. The linear graph shows the elderly having the depression condition between 2020-2024 by classifying according to the ADL level. Furthermore, both bar charts are comparing the problem of their eyesight and the problem of their sleeping by choosing according to the year surveyed. Thus, the user can choose the data according to the year surveyed, village, ADL level, and their own ailment as shown in Fig. (9).

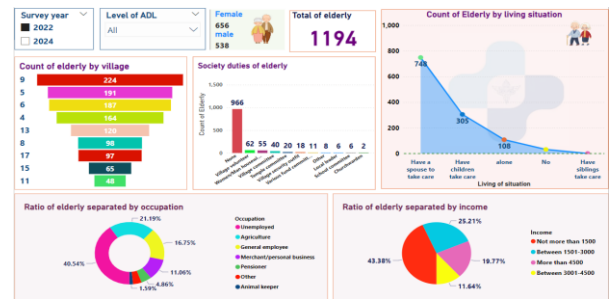


Fig. 6: The statistical report on the elderly's living

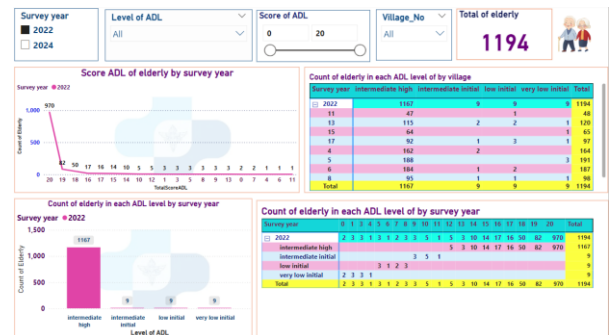


Fig. 7: The report on the elderly's score ADL

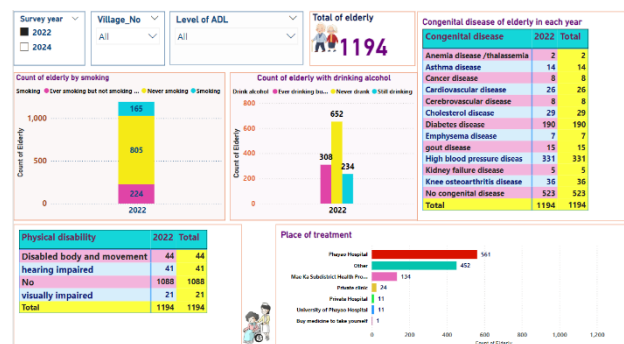


Fig. 8: The reports on the elderly's behavior, ailment, and physically disabled

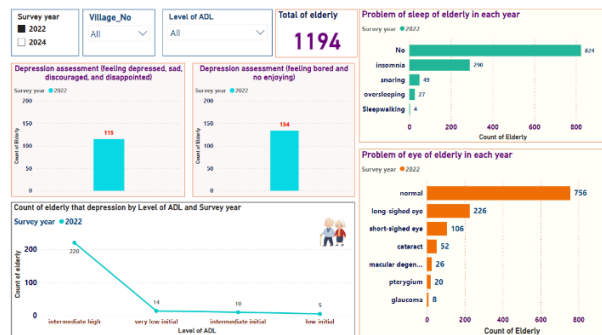


Fig. 9: The statistical report on the elderly’s health problem and the depression condition evaluation

Table 1: Results on the satisfaction towards data warehouse system

Question items	\bar{x}	S. D	Level
Speed, and correctness in bringing the data into the intelligent business system	4.25	0.44	high
Speed in processing of the system	4.05	0.22	high
Correctness and reliability of the system	4.30	0.47	high
Easy to use the system	4.10	0.45	high
Beauty and interesting	4.50	0.51	highest
Reporting form of analysis easily understanding	4.40	0.50	high
The system can support the decision-making	4.10	0.45	high
Details in results of data analysis shown	4.00	0.46	high
Improving the data as needed	4.35	0.49	high
The privilege determination in accessing the system	4.00	0.46	high
Total	4.21	0.08	high

The Result of the User's Satisfaction

In the study on the user's satisfaction with the system, the data was collected through a questionnaire by ten informants who are the main users of the business intelligence system: consisting of operators and administrators from Maeka Health Promotion Hospital. The study result is shown in Table (1).

From Table (1) the experimental result of the development of a data warehouse system is to support the elderly's health care at Maeka Healthcare Hospital, phayao province by applying the Microsoft Power BI program to make a questionnaire on the user's satisfaction towards the system function. The data are collected from 10 informants. The user's satisfaction with the system can be concluded that the satisfaction overall is at a high level ($\bar{x} = 4.21$, S.D. = .008).

Discussion

The development of the data warehouse system is created in accordance with the related literature. It shows

that the system has used the technique of data mixture to be the same standard under the data warehouse which is designed for Online Analytical Processing (OLAP) by applying the star schema model consisting of a fact table and dimension table in analyzing the data in different dimensions. This will make the reported data more diversities which is incongruent with Minh *et al.* (2022); Akbar *et al.* (2020); Orlovskiy and Kopp (2020). The researcher applied data warehouse and business intelligence using the dimensional model. In addition, the results of this research are similar to Ali *et al.* (2016); Pipatjessadukul and Pinngern (2019); Gonçalves *et al.* (2023). These researchers are applying BI tools for interactive dashboard visualization. In this study, the BI system is created the dashboard reports like charts and tables by Microsoft Power BI. Dashboards and executive reports are powerful and easy to data analytics and decision making. This is because the researcher has created the system in accordance with the user's needs. Therefore, the data warehouse system is suitable and is able to be applied easily in the application web.

The results of this research indicate that BI applications have the ability to visualize the summative data promptly which makes the administrators and the staff in making better and easier decisions and in a limited time. This is because the presentation of the report data was clear, correct, and easy to understand.

In this study, the data are collected from 20 samples: The hospital director from Maeka Health Promotion Hospital, RN nurses, general staff, and the key persons of the village public health volunteers by using a questionnaire on the topic of "The satisfaction of the users towards the data warehouse system". The result shows that the satisfaction of the users towards the business intelligence system is at a high level. Also, the satisfaction with the use of the system is at $\bar{x} = 4.21$. In summary, the result of this study infer that the satisfaction is at a high level.

Conclusion

The objective of this study is to develop a business intelligent system in order to support the elderly's health care by using an online analytic processing technique and presenting the data visualization in the dashboard report. The data source is gained from the database of the information system on a survey of the elderly's health condition and changed the data into the data warehouse in order to support the decision-making about the plan of the daily activity and taking care of the elderly for the administrator and to design the data structure called star schema. The advantages of this applied research are to present the information and create the report in different forms which are suitable for the perspective on analysis, showing the relation and analyzing the results of the possibly occurring trends and the organization's

requirement leading to planning of mauka health promotion hospital. The assessment of the users' satisfaction with the system, shows that the satisfaction with the system is at a good level. It could be concluded that the development of an intelligent business system for supporting daily activities and caring for the elderly's health can increase the administrator's proficiency in making a decision.

This study will be taken to analyze the data in order to support the decision in the aspect of the elderly's health care promotion activity. Thus, if this research result is applied to other aspects to fulfill most, the future study ought to bring the technique of the data warehouse to help search for the correlation form of the data to create the model of data prediction to make a decision more accurately. In addition, the integration of machine models and AI capabilities in the health domain is vital for development both in terms of speed of elderly care and quality of service.

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Ethics

The researcher affirmed this article is original work and has not been submitted for publication elsewhere. The author have reviewed and approved the manuscript.

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