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Original Article

Business Intelligence Implementation using Power BI for Decision Making in Peruvian Banking Systems

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Abstract *- The research work focuses on decision-making based on banking systems. The database of the banking systems has a number of related tables due to the large bank movements and bank transactions. Therefore, the information analysis is complicated, so they can subsequently make decisions in all areas of the banking system. The objective of the research work is to implement business intelligence using Power BI for decision-making in Peruvian banking systems. In this way, it contributes to the banking organizations achieving a future vision and having full visibility for decision-making. The methodology applied is Kimball, which allowed the development and design of business intelligence using Power BI in banking systems at a given time. The result obtained is detailed reports for decision-making, with important data regarding the movements carried out, thus showing the place where the greatest collection in movements has been obtained. The fixed deposit account is the type of card that obtained the highest amount of movements in dollars and soles within the banking systems. Thanks to the implementation of business intelligence, banking systems will have better visibility for decision-making.*

Keywords *- Banking system, Business intelligence, Decision making, Kimball methodology, Power BI.*

1. Introduction

Globally, banking organizations have been in high demand in recent quarters. Since social confinement, there are not many restrictions, and society began to exercise their jobs. Moreover, with that, the system began to operate more frequently, either by large bank movements or banking transactions.

Today in Peru, the level of risk assumed is high in the banking systems. Because it is complex and requires a lot of time for analysis, where bad decisions can be made that affect the business and does not represent the company's competitive advantage [1]. The database of the banking system is very complex due to the large bank movements and transactions, which makes it difficult to perform an analysis.

In Peruvian banks, strong competition exists to attract and retain customers and issues such as loss prevention and risk management. These are some common phenomena in the banking sector these days [2]. The result is business intelligence (BI) technology, which can be used to analyze, detect fraud, predict, and understand customer behavior to rescue banks.

Organizations are increasingly adopting business intelligence as it enhances decision-making and understanding of the factors that influence these decision-making processes, which need to receive a great deal of academic interest [3]. On the other hand, the database of these organizations has a number of related tables. Therefore, the analysis of the information is complicated [5]. Implementing BI business intelligence will help make decisions, taking into account important or necessary data for certain functions or processes.

Besides, the Power BI tool provides visual analysis in well-interactive dashboards in companies or organizations where all team members can share their knowledge in real-time [6]. No specialized programming knowledge is required. On the other hand, the Kimball method is used to build a data warehouse or data set oriented to a company or organization, integrated and immutable over time. Thus, in this way, it helps to make decisions based on the context being used [7].

The research work is very important because it will benefit banking organizations with the implementation of business intelligence. To have quick access and timely analysis for decision making, taking into account the important or necessary data for certain functions or processes in the areas that need changes or improvements for the benefit of Peruvian banking systems.

The objective of the research work is to implement business intelligence using Power BI to improve decision-making in Peruvian banking systems.

The paper is structured as follows: in Part 2, the literature review; in Part 3, the methodology; in Part 4, the case study; in Part 5, the results and discussions; and finally, in Part 6, the conclusions.

2. Literature Review

In principle, the research has allowed detailing the importance of the implementation of business intelligence, in banking organizations, due to the great decisive contribution, through the use of data analysis decisions. These organizations use business intelligence to have a strategy for the decisions they must make.

In the banking sector, knowing how to optimize processes is important. In this sense, the author [8] raises the problem of optimizing quality in decision-making, in the analysis of products, in the banking sector in order to develop higher-quality products for banks. Therefore, it uses Business Intelligence (BI) as a stable analysis tool that can display complete banking information for each product.

Banks process large amounts of data in their daily operations. Therefore, the authors [10] indicate that a large amount of data requires fast and instantaneous tools which are able to deliver information at high speed. Therefore, they present one of the tools that can be used for business analysis, which is the OLAP cube—banking case studies, where loan approval processes use business intelligence to make and analyze business decisions.

On the other hand, [11], they evaluate all identified variables and research gaps, paving the way for the conceptualization of models, which can be used later to calculate the impact of Power BI on future banking performance. This study will be the first preparatory tool to arrive at a model capable of assessing and quantifying the impact of BI on the future performance of banks. For this reason, the authors focus on solving the obvious gaps that exist in the banking sector. This strengthens the BI approach for all available variables and allows banks to establish policies based on the relationships identified between the survey variables.

In the same way, the author [12] provides sustainability to commercial banks by influencing their financial condition. Therefore, a hypothesis was formulated, which assumes the use of the Business Intelligence management system. The financial condition of commercial banks is improving. In addition, the positive impact of using the BI system in a particular industry on the financial position of a commercial bank was identified.

Finally, the authors [13] identify the influence of economic information on the unemployment of commercial banks operating in the state. The company's population consists of commercial bank executives and the employees who work for them. Therefore, they provide the strategic objectives and the necessary knowledge to achieve the goals of future end-users and managers. At the same time, it is recommended to monitor the evolution of the business intelligence field, use it more appropriately, and improve strategic performance. Conducting future research, and deepening the use of the business, according to an analytical approach in banking systems.

In conclusion, several research works related to business intelligence have been observed. Since different authors have proposed the solution with their respective methodologies, they have obtained better results and have provided knowledge on how to deal with business intelligence for banking organizations. However, there are some points that they have not been able to complete in their overall objectives related to BI implementation.

3. Methodology

In this work, the Kimball methodology was applied, a methodology used for reconstructing a data warehouse. That is a set of data aligned in a specific area, either for a banking system. Figure 1 shows the steps of the Kimball methodology and to what extent each is involved in developing and designing business intelligence. These are project planning, then requirements and business analysis, dimensional modeling, and finally, design.

3.1. Stages of the Methodology

3.1.1. Project Planning

In the first phase, planning is at work to determine the description and monitoring of the data warehouse project, including commercial buildings and feasibility assessments. Project planning focuses on resources, profiles, activities, duration, and order [15].

3.1.2. Business Requirements and Analysis

In the second phase, the business requirements determine the basis for the next three phases: parallel, data, and technology-oriented parallel applications, so it is very critical and shows the initiative with functional diagrams for the approach of dimensional modeling.

3.1.3. Dimensional Model

In this fundamental phase, start with a matrix in which the dimensionality of each guide is established. Therefore, each concept of the company gives a degree of different details, as well as various hierarchies, the dimensional model of the company and the granularity of modeling of each indicator [16].

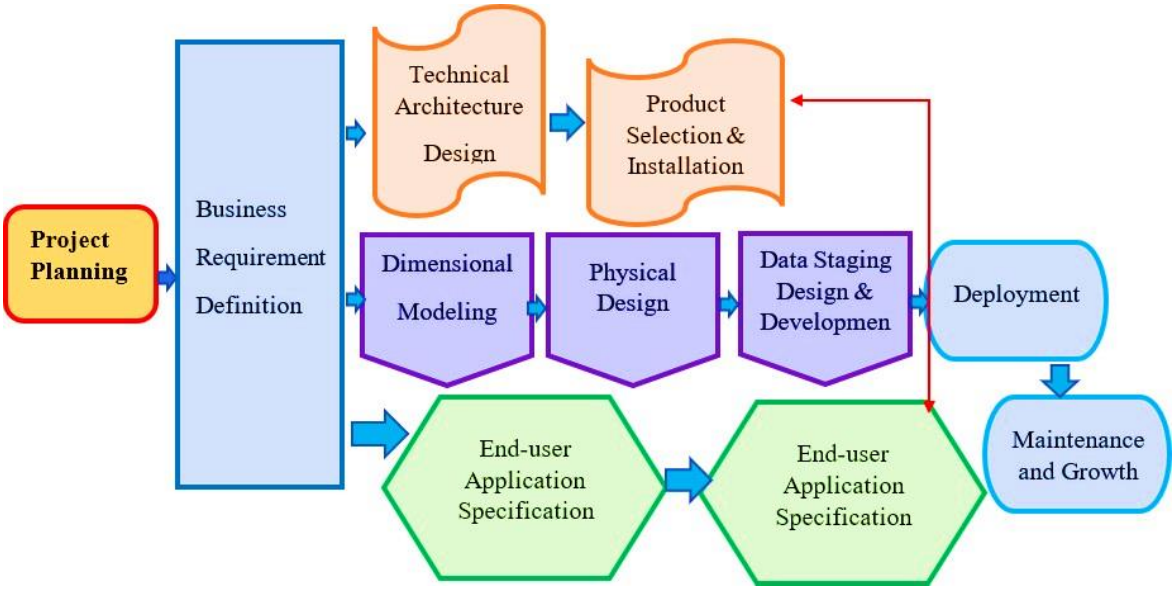


Fig. 1 Phases of the Kimball methodology

Source: Gartner (February 2021)

Fig. 2 Gartner BI Quadrant [18]

3.1.4. Physical Design

On the other hand, the authors [17] emphasize that the data warehouse's physical design phase focuses on choosing the structures needed for the logical design. A basic component of the development is the definition of the standards related to the data warehouse environment. This phase also determines the reports in Power BI.

Figure 2 shows the Gartner Magic Quadrant as of February 2021. It shows the leaders who are leading the way in business intelligence. First of all, Microsoft, since Power BI is integrated within it. That it is based on providing analysis and easy access to provide solutions for decision making

3.2. Gartner Quadrant for the BI Platform

3.2.1 Data Warehouse Extraction Process

Figure 3 shows the data warehouse data extraction architecture in 3 parts: Extract to load transformation (ETL), data warehousing, and restitution.

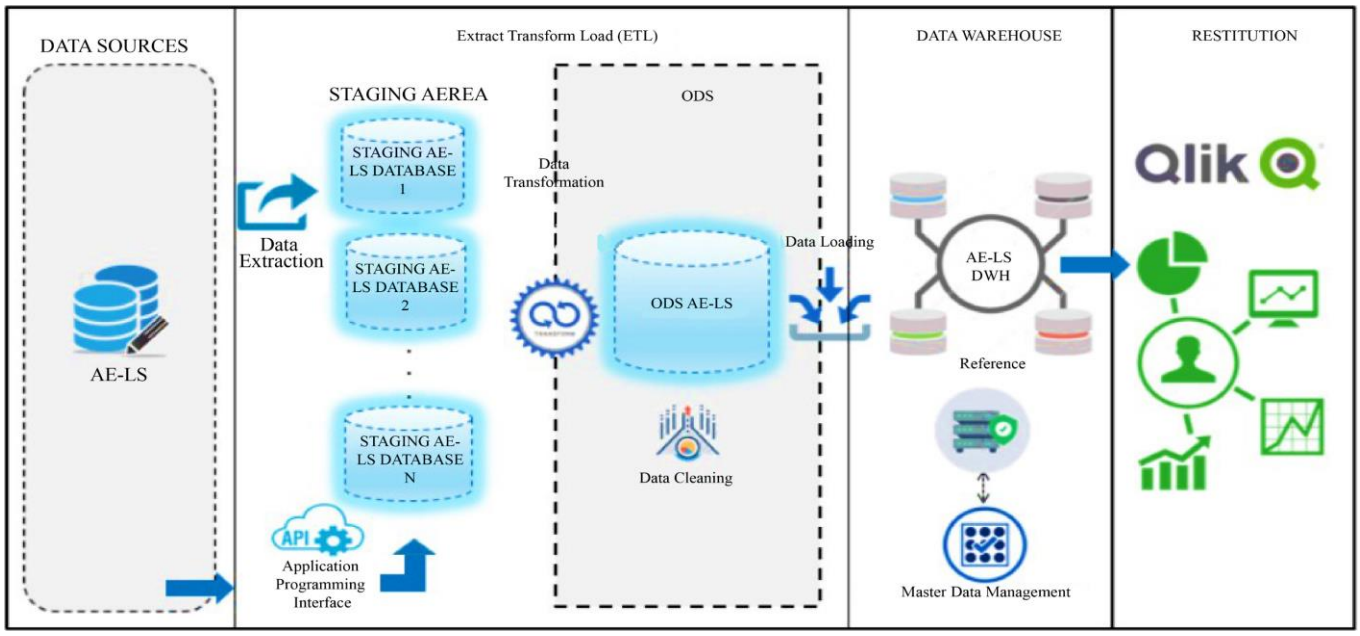


Fig. 3 Data Warehouse Architecture [16]

The extraction and transformation of load are constituted by the extraction of data from the banking systems of the relational database, to be later analyzed by all the data extracted from the source. If the established rule is met, the data is transformed and loaded into another data warehouse database [20]. In data warehouse is the implementation of a dimensional database model, developed in SQL server, to make a quick analysis and perform fast and complex queries. In the same way, it stores the transactions carried out in the banking system. On the other hand, the restitution is the one that receives the results of the dimensional model with the Qlik tool, which allows the exploration of the data [21].

4. Case Study

4.1. Project Planning

In banking systems, it has been de- fined for implementing business intelligence using Power BI for decision-making in banking systems. In Table 1, the vision andmonitoring of the project are determined.

Table 1. Project vision

Name	Description
Geographic	The project will benefit Peruvian banking organizations by having a timely analysis for decision-making.
Organizational	It will streamline the process of extracting information from savings accounts.
Functional	It will further facilitate the collection of information on savings accounts in a fast and efficient manner. On the other hand, it will help the banking systems to make decisions that choose the most appropriate one.
Benefits	-It will be useful for decision-making -The information gathered by the project will be easily accessible for application to business intelligence. -You can have a vision of the company's future, all thanks to analysing the information collected.

4.2. Business Requirements and Analysis

Figure 4 shows the functional diagram of the representation of the selected points of the banking system which will be considered, for the application of business intelligence, either in soles or dollars: Such as savings account, client, type of transaction, date of transaction, and time of the transaction, with their respective attributes.

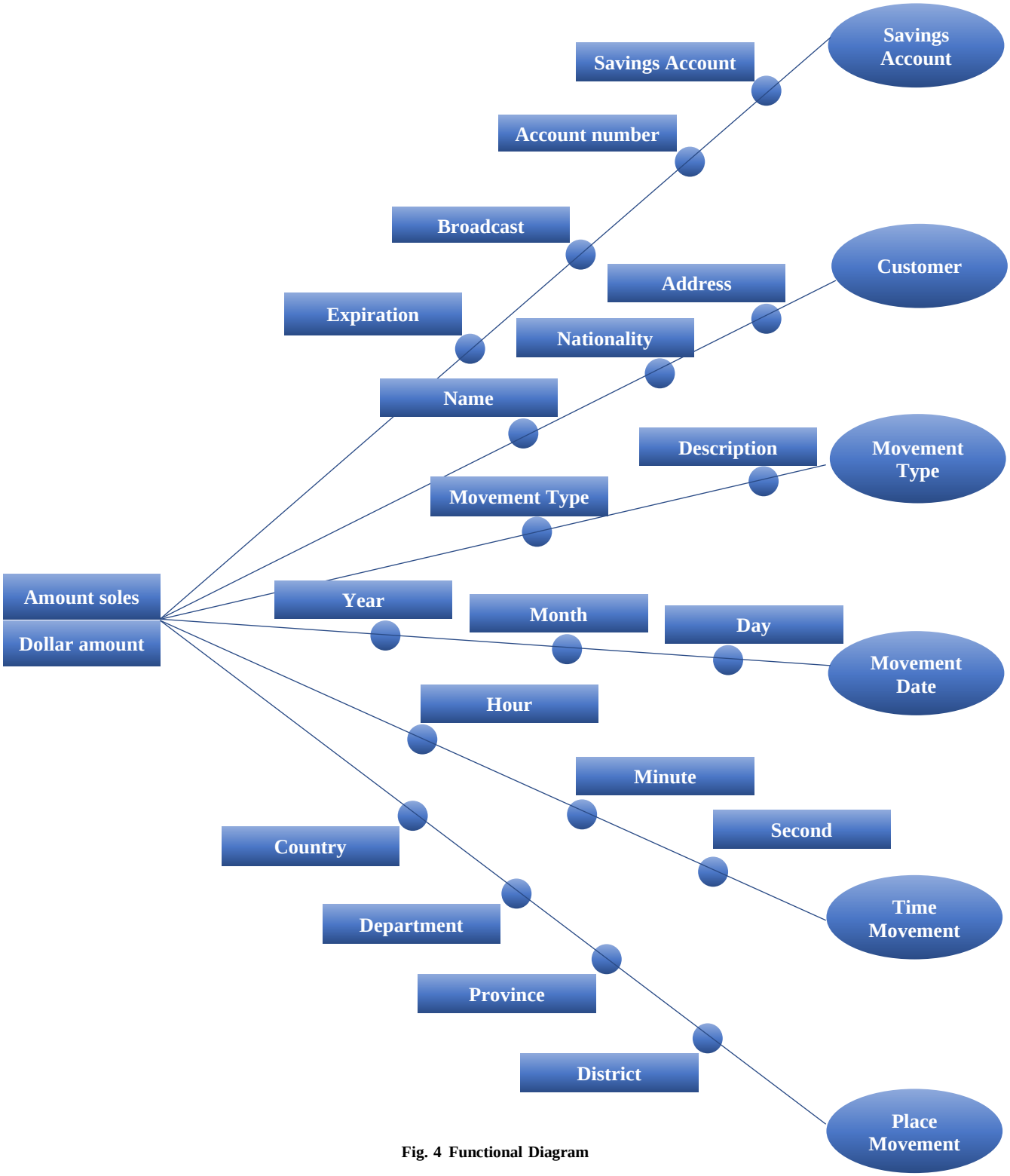


Fig. 4 Functional Diagram

Table 2. Application Dimensions

Dimension	Description
Customer Dimension	This dimension provides customer data.
Savings Account Dimension	This dimension provides the main data of the Savings Account.
Dimension Type Movement	This dimension will give information on the type of movement being executed.
Dimension Date Movement	This dimension gives the date on which the movement took place.
Dimension Time Movement	This dimension provides the time at which the movement took place.
Dimension Place Movement	This dimension gives information about the place where the movement took place.
Table Made Movement	In the fact table, motion: will display an attribute that reports the code of the motion; it is the only degenerate dimension that has been added.

4.3. Dimensional Model

Table 2 shows the different dimensions proposed for business intelligence applications, with their respective descriptions, detailing the information of each dimension established.

Figure 5 shows the dimensional database created in the SQL server, according to the objectives established in the project planning, based on the functional diagram. The proposed dimensional diagram reflects the star model of the database since it consists of a single data matrix involving multiple connected dimensional matrices with the same essence of extending its scope of information.

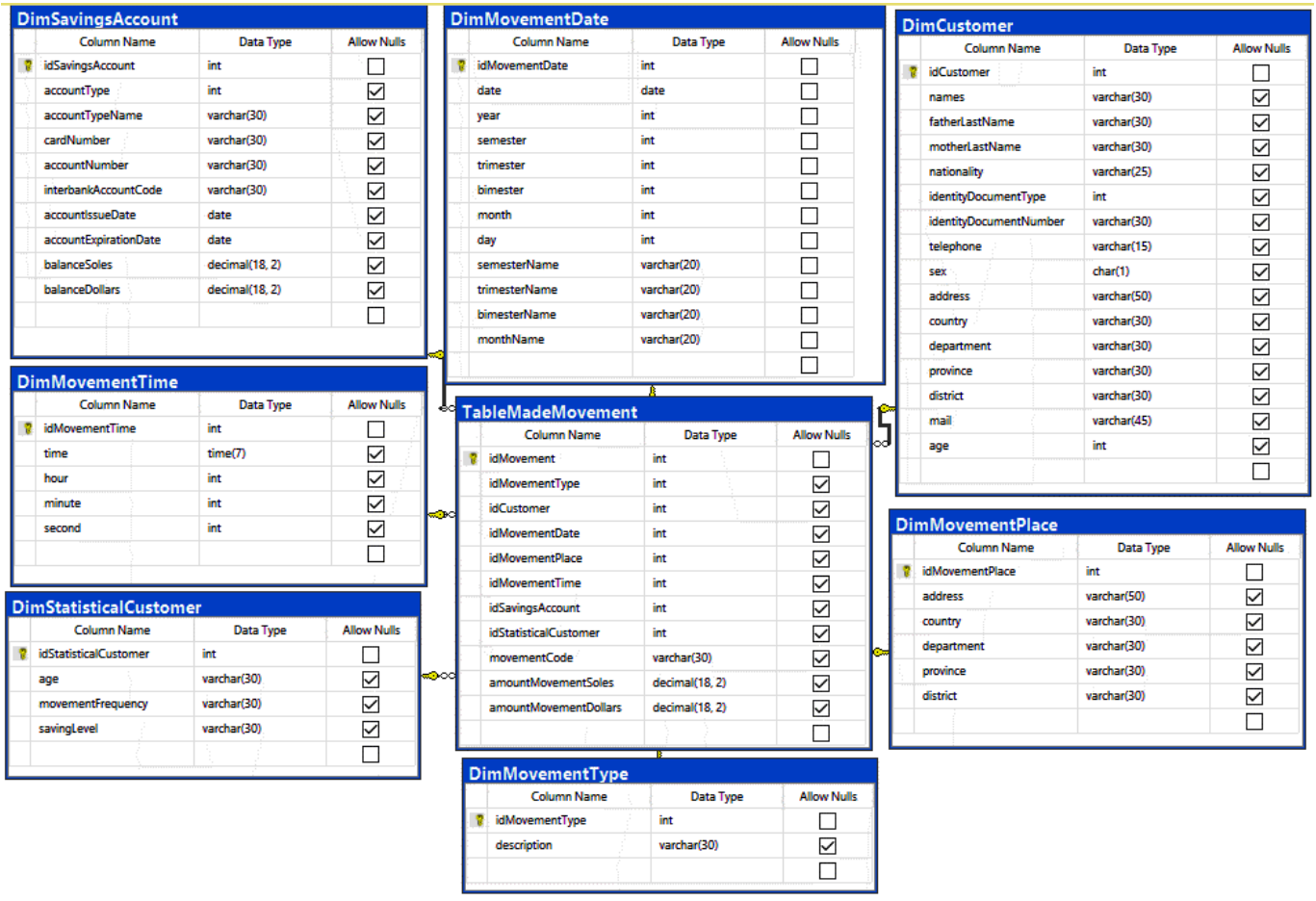


Fig. 5 Dimensional model for the banking system

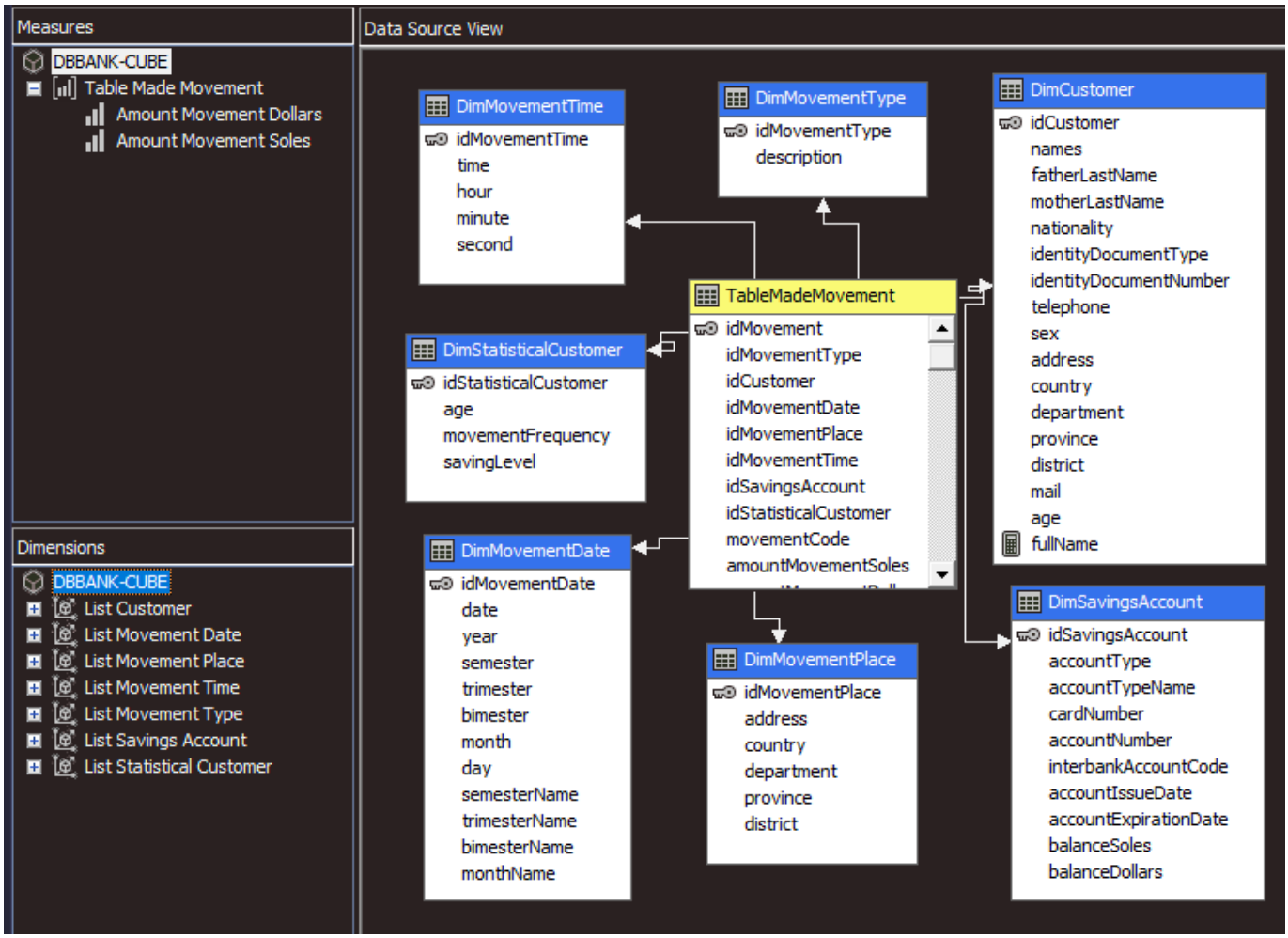


Fig. 6 Banking system data cube

4.4. Physical Design

In this phase, the business intelligence development design was applied. For this purpose, a data cube of the banking system was made to analyse the data, simplifying the dimensional model database quickly. In Figure 6, a cube of the banking system is shown, which analyzes the table movement made, the amount of movement in dollars and the amount of movement in soles. It also displays the list of dimensions: customer list, transaction date list, transaction location list, internal transaction time list, transaction type list, savings account list and statistical customer list, which will help to sample the reports of the Peruvian banking system, using Power BI.

5. Results and Discussions

5.1. About the Case Study

For the case study, business intelligence was implemented using POWER BI in the banking systems to facilitate decision-making. Taking into account important data to develop certain functions and processes. Since banks process large amounts of data in their banking and banking transactions, likewise, Figure 7 shows a Report by Movement Amount dollars by type of movement. Therefore, the letter" M" stands for Millions. The light blue color represents the interbank transfer with 6.88 million and 55.77%; on the other hand, the blue color represents the payment of an institution or company with 2.31 million and 18.71%, the orange color represents a payment of services with 1.26 million and 10.19%, likewise, the purple color represents another bank account, with 0.95 million and 7.7% and the pink color represents telephone recharge with 0.94 million and 7.62%.

Likewise, Figure 8 can view the report Number of transactions Suns by type of transaction. In which interbank transfers account for 27.41M, equivalent to 55.66%. Likewise, for payment of institution or company with 9.68M, equivalent to 19.66%; for payment of services with 5.02M, equivalent to 10.21%, for telephone recharge with 3.61M, equivalent to 7.32%; and to another bank account with 3.52M equivalent to 7.15%.

In a cube, it is necessary to put a variable to differentiate from the other name and only accept a single name. Therefore, the" E" was used to differentiate from the other name and

easily search for specific data. Likewise, Figure 9 shows the report by dollar and soles movement amount by Department E, in which the total amount in dollar movement is 12,329,609.00. On the other hand, for insoles, the total amount by type of movement, country, and department is 49,239,707.00.

Figure 10 can see reports by Dollar Movement Amountby type of account Name E and Dollar Movement Amountby Savings Level E. Therefore, the salary account is 6.23M with 50.56% in a type of account name. Likewise, the simple account is 6.1M with 49.44%. On the other hand, in savings level less than 1500 is 6.08M with 49.29%, between 1500 and 400 is 3.45M with 27.98% and more than 4000 in 2.8M with 22.73%. The total dollar amount in movement is 12,329,609.00.

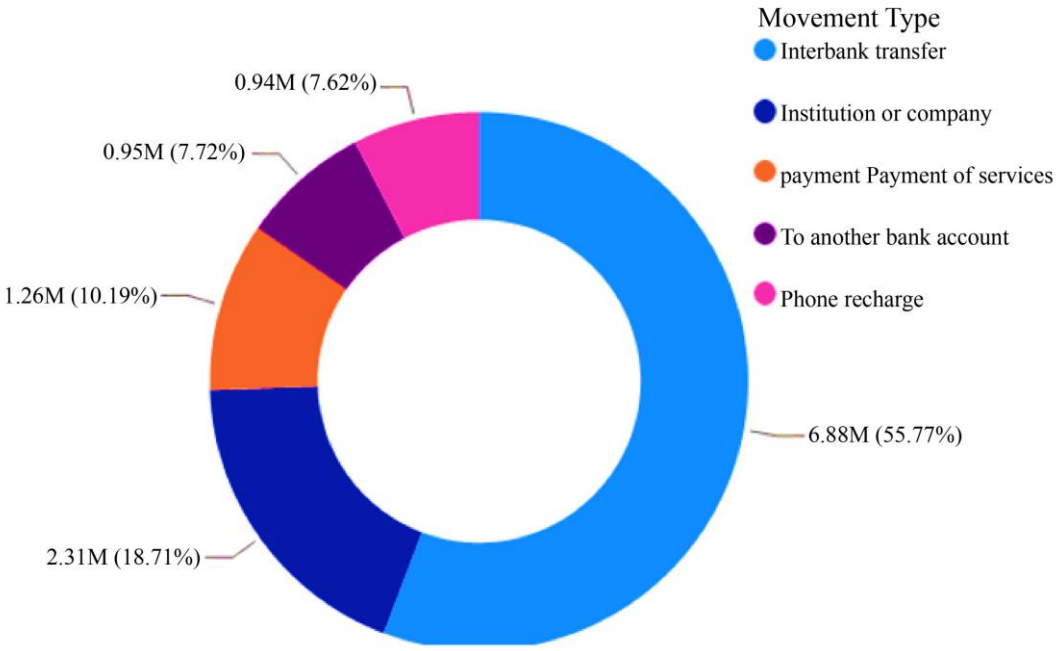


Fig. 7 Amount Movement Dollars by type of movement

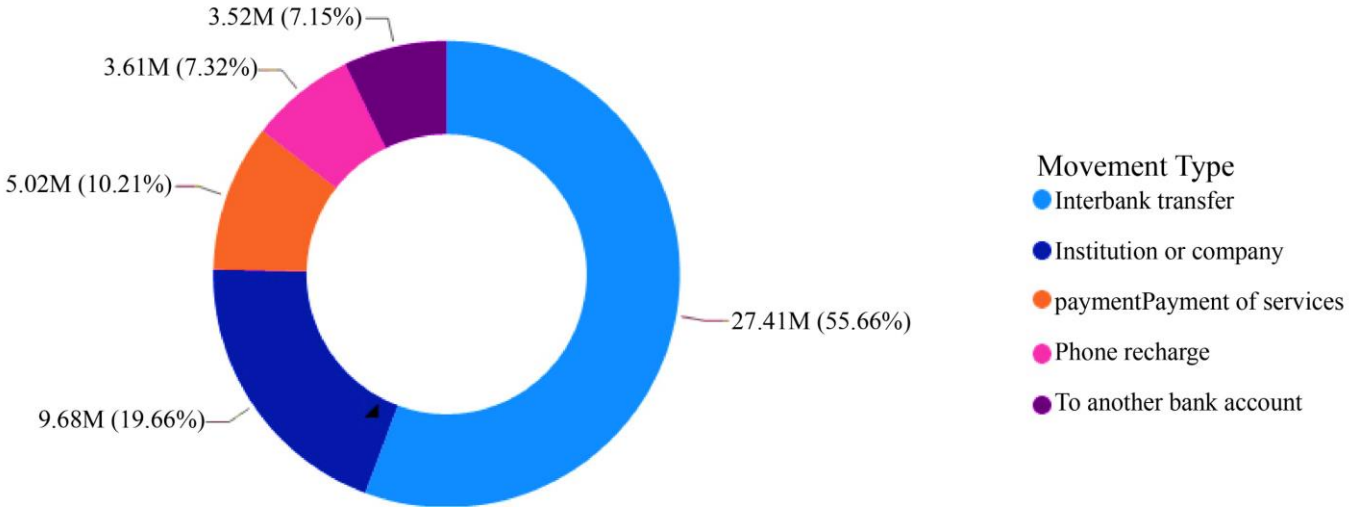
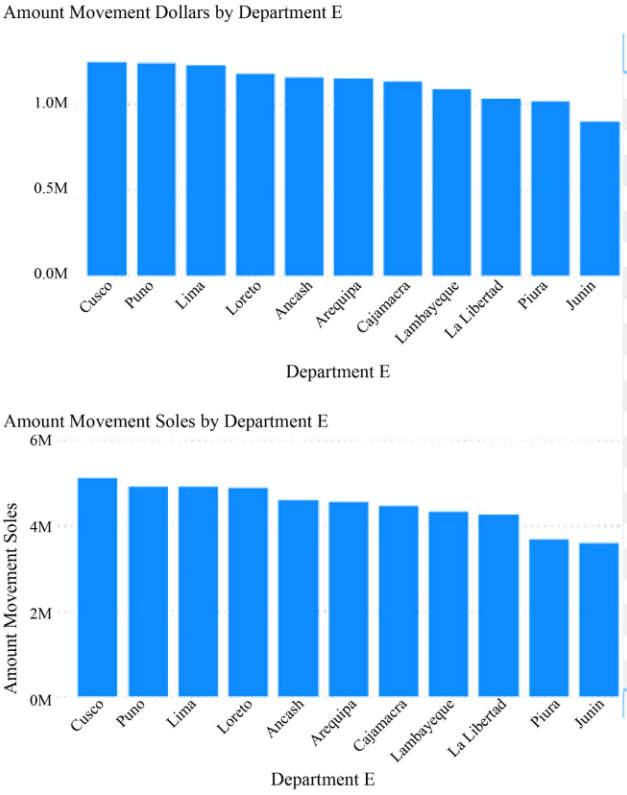


Fig. 8 Number of movement suns per movement type

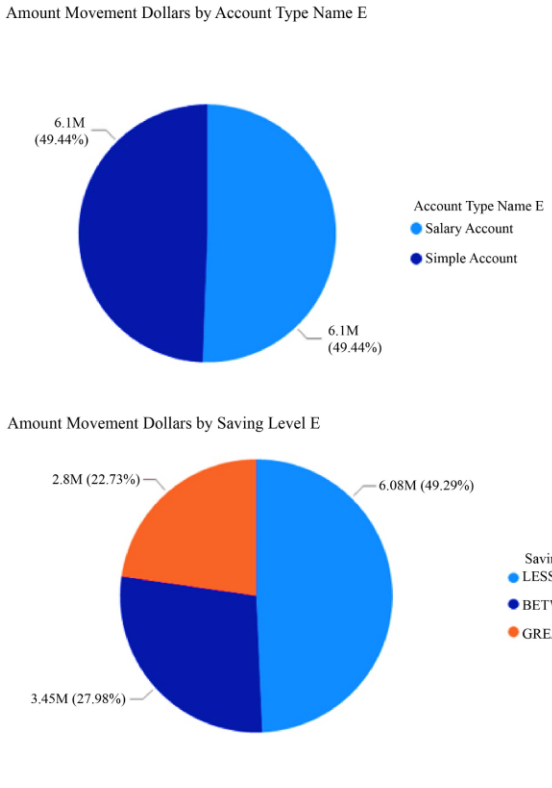


Year E	Amount Movement Dollars
2000	371,578.00
2001	405,824.00
2002	639,080.00
2003	568,331.00
2004	492,822.00
2005	665,134.00
2006	587,362.00
2007	419,159.00
2008	626,407,00
2009	623,474.00
2010	705,491.00
2011	762,475.00
2012	606,190.00
2013	492,399.00
2014	473,713.00
2015	787,655.00
2016	464,373.00
2017	570,621.00
2018	614,176.00
2019	483,254.00
2020	559,786.00
2021	410,305.00
Total	**12,329,609.00**

Movement Type	Amount Movement Soles
Institution or company payment	9,680,834.00
Interbank transfer	27,408,874.00
Payment of services	5,024,957.00
Phone recharge	3,606,731.00
To another bank account	3,518,311.00
Total	**49,239,707.00**

Country	Department	Amount Movement Soles
Peru	AncashPuno	4,596,082.00
Peru	Arequipa	4,553,303.00
Peru	Cajamarca	4,876,811,00
Peru	Cusco	4,910,977.00
Peru	Junin	3,588,107.00
Peru	La Libertad	4,323,795.00
Peru	Lambayeque	4,257,088.00
Peru	LimaPiura	4,464,277.00
Peru	Loreto	4,904,488.00
Peru	Piura	3,671,174,00
Peru	Puno	5,093,605.00
Total		**49,239,707.00**

Fig. 9 Amount Movement Dollars and soles by department



Year E	Account Type Name E	Sex E	Amount Movement Dollars
2015	Salary Account	F	134,278.00
2015	Salary Account	M	77,559.00
2015	Simple Account	F	90,757.00
2015	Simple Account	M	68,984.00
2016	Salary Account	F	109,435.00
2016	Salary Account	M	66,452.00
2016	Simple Account	F	152,544.00
2016	Simple Account	M	77,393.00
2017	Salary Account	F	161,112.00
2017	Salary Account	M	145,365.00
2017	Simple Account	F	205,921.00
2017	Simple Account	M	126,682.00
2017	Salary Account	F	165,105.00
2017	Salary Account	M	82,358.00
2018	Simple Account	F	226,041.00
2018	Simple Account	M	94,827.00
2018	Salary Account	F	124,037.00
2018	Salary Account	M	84,560.00
2018	Simple Account	F	183,575.00
2019	Simple Account	M	100,650.00
2019	Salary Account	F	203,914.00
2020	Salary Account	M	155,286.00
2020	Simple Account	F	159,404.00
2020	Simple Account	M	146,530.00
2020	Salary Account	F	210,677.00
2020	Salary Account	M	104,755.00
2020	Simple Account	F	181,258.00
2021	Simple Account	M	90,672.00
2021	Salary Account	F	134,178.00
2021	Salary Account	M	90,919.00
2021	Simple Account	F	129,265.00
2021	Simple Account	M	64,797.00
			12,329,609.00

Fig. 10 Number of transactions Dollars per type of account Name E and per Savings Level E

On the other hand, Figure 11 shows the report by the amount of Dollar Movement by Bimonthly Name E. In the third two-month period, there were 3.68M, equivalent to 29.84%. In the fourth two-month period, there were 3.24M, equivalent to 26.25%. In the second two-month period, there were 2.81M, equivalent to 22.75%, and in the first half of the year, there were 2.61M, equivalent to 21.16% in terms of the number of transactions.

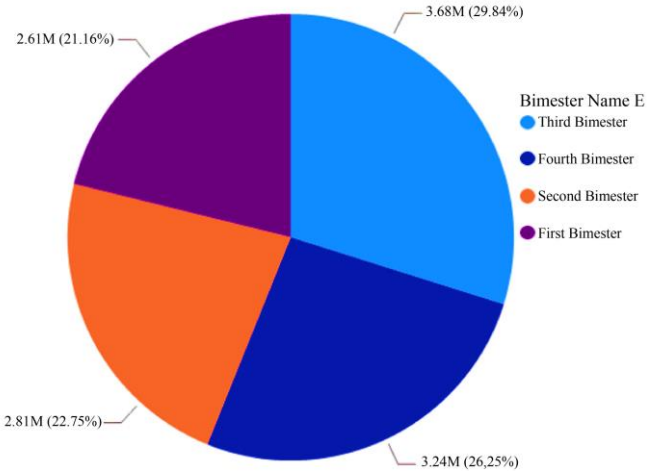


Fig. 11 Amount Movement Dollars by Bimester Name E

In Figure 12, a report is shown by the amount of movement Dollars per month Name E. In which a greater amount of movement of 1.95M is obtained with 15.85%; in June, there is 1.73M with 13.99%. In July, there is 1.73M with 13.99%; in August, there is 1.51M with 12. 25%, in April 1.46M with 11.86%, in March 1.51M with 12.25%, in January 1.33M with 10.81%, and in February 1.28M with 10.35%.

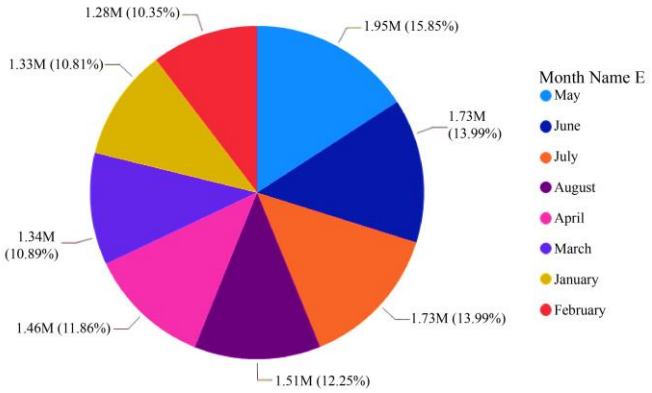


Fig. 12 Amount Movement Dollars by Month Name E

Finally, in Figure 13, a report by Amount of Dollar Movement by Semester Name E is displayed. In which first half of the year, there was a greater amount of movement of 9.09M with 73.75%, likewise in the second half of the year, there was 3.24M with 26.25% of the movement in dollars.

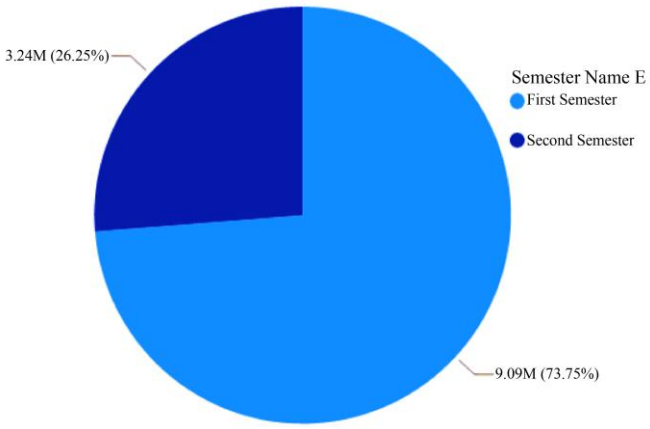


Fig. 13 Amount Movement Dollars by Semester Name E

5.2. About the Methodology

For the point of the discussion section, the comparison table of the tools used for the development of the business intelligence implementation, according to the methodology implemented in work, is observed. Both Inmon and Kimball methodologies have their own way of integrating and exploiting information from many different source systems [22].

Table 3 shows the comparison between the Inmon and Kimball methodologies, with 5 criteria: budget, time, specialty, scope, scope, and maintenance. The 4 points for each criterion were analyzed by experts in the field who are familiar with the methodology. In this case, Kimball obtained 20 points and Inmon 16 points. Therefore, according to the experts, the Kimball methodology was chosen for having the highest score.

Modeling based on the Kimball methodology is quick to build, and no standardization is required. Similarly, the star modeling scheme is easier to understand due to its denormalized structure, which reduces queries and analysis. It also enables fast restoration of data warehouse data. In addition, the data is separated into a data table and a dimension table and, finally, focused work on personal part areas instead of the whole company [23].

In the Inmon methodology, on the other hand, the complexity increases when adding several tables to the data model. It is also time-consuming to set up and deliver [24]. Likewise, Inmon requires specialities that effectively manage the data warehouse. Therefore, a comparison is made to see why Kimball was chosen and used and why not other methodologies related to business intelligence, such as Inmon, Hephaestus, and Pentaho.

Table 3. Kimball- Inmon

Item Methodology	Kimball	Inmon
Budget	Low initial cost.	High initial.
Weather	Its development time is shorter.	More time is needed for development.
Specialty	Medium professional team.	Highly professional team.
Scope	Personal arts.	All companies.
Maintenance	Maintenance is more complicated.	It is easier to maintain.

6. Conclusion

In conclusion, implementing business intelligence using Power BI allowed us to have detailed reports for decision-making within the Peruvian banking systems. Thanks to this business intelligence implementation, using Power BI, important data were obtained regarding the movements made. Thus, it shows the place where the greatest amount of transactions has been obtained, showing that the fixed deposit account is the type of card that obtained the greatest amount of transactions in dollars and soles.

With respect to the methodology, the Kimball methodology was used to develop and design business intelligence for decision-making in banking systems effectively and efficiently. Likewise, with the help of Power BI, it was possible to create reports based on the business intelligence data implemented in Peruvian banking systems.

A limitation found in the research work is that it was not possible to contact the representatives of the banking systems to question them about the problems they had at the time of implementing business intelligence for the analysis of their information for decision-making. In future work, it is suggested to complement it with a comparative analysis of different countries regarding implementing business intelligence in banking systems. Also, apply with other methodologies such as Inmon, Hephaestus, and Penthao. In addition, the use of other disruptive technology that allows complements the study carried out.

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