

# Efficient Use of OLAP Cube to Analyze Business Data for Decision Making

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## ABSTRACT

*OLAP is a software that allows users to analyze information from multiple database systems at the same time. Using OLAP technique, analysts easily extract and view business data from different points of view. Analysts frequently need to group, aggregate and join data. These operations in relational databases are resource intensive. With OLAP, data can be pre-calculated and pre-aggregated, making business data analysis faster. OLAP databases are divided into one or more cubes. The cubes are designed in such a way that creating and viewing reports become easy to make business decisions faster. The OLAP Cube consists of numeric facts called measures (it is property on which calculations can be made) which are categorized by dimensions.*

**Keywords:** OLAP, pre-calculate, OLAP database, pre-aggregate, relational database

## INTRODUCTION

When data is grouped or combined in multidimensional matrices, it is called Data Cubes. Also known as "Multidimensional databases [7]," "materialized views," and "OLAP (On-Line Analytical Processing) cube [5]."

The OLAP cube is a data structure optimized for very quick data analysis.

The OLAP Cube consists of numeric facts called measures (*it is property on which calculations can be made*) which are categorized by dimensions.

OLAP Cube is also called the **hypercube**. [1]

Usually, data operations and analysis are performed using the simple spreadsheet, where data values are arranged in row and column format. This is ideal for two-dimensional data. However, OLAP contains multidimensional data, with data usually obtained from a different and unrelated source. Using a spreadsheet is not an optimal option. The cube can store and analyse multidimensional data in a logical and orderly manner.

A Data warehouse would extract information from multiple data sources and formats like text files, excel sheet, multimedia files, etc.

The extracted data is cleaned and transformed. Data is loaded into an OLAP server (or OLAP cube) where information is pre-calculated in advance for further analysis.

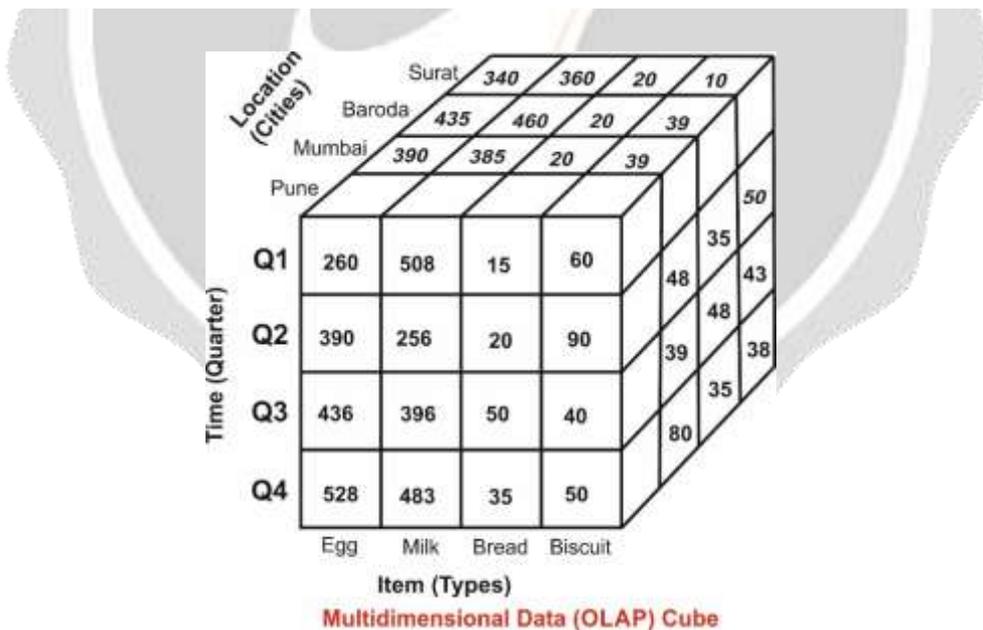
**OLAP CUBE OPERATIONS**

[2] Consider the data of a shop for items sold per quarter in the different cities. The data is shown in the table. In this 2D representation, the sales for different cities are shown for the time dimension (organized in quarters) and the item dimension (classified according to the types of an item sold). The fact or measure displayed in rupee sold (in thousands).

Time	Location=Surat				Location=Baroda				Location=Mumbai				Location=Pune			
	Egg	Milk	Bread	Biscuit	Egg	Milk	Bread	Biscuit	Egg	Milk	Bread	Biscuit	Egg	Milk	Bread	Biscuit
Q1	340	360	20	10	435	460	20	15	390	385	20	39	260	508	15	60
Q2	490	490	16	50	389	385	45	35	463	366	25	48	390	256	20	90
Q3	680	583	46	43	684	490	39	48	568	594	36	39	436	396	50	40
Q4	535	694	39	38	335	365	83	35	338	484	48	80	528	483	35	50

**Table 1.1: 2D Representation of Data**

The data from above table can be represented in the form of a 3D (3-Dimensional) data cube [4], as shown in fig:



**Fig 1.1: 3-Dimensional Data Cube (OLAP Cube)**

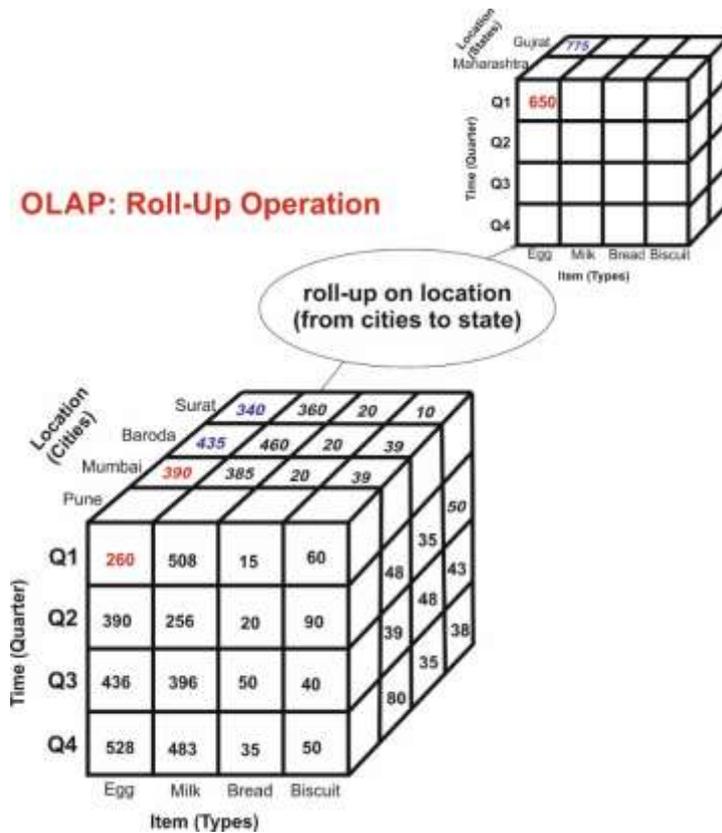
**ROLL-UP OPERATION:**

Roll-up [3] is also known as "consolidation" or "aggregation." The Roll-up operation can be performed in 2 ways

- a. Reducing dimensions
- b. Climbing up concept hierarchy. Concept hierarchy is a system of grouping things based on their order or level.

Consider the following diagram:

In this overview section, roll-up operation performed by climbing up (merging) in concept hierarchy of **Location dimension (City to State)** [6]



**Fig 1.2: Roll-up Operation**

- In this example, cities Pune and Mumbai are rolled up into State Maharashtra.
- The sales figure of Pune and Mumbai are 260 and 390 respectively. They become 650 after roll-up.
- In this aggregation process, data is location hierarchy moves up from city to the state.

**DRILL-DOWN OPERATION:**

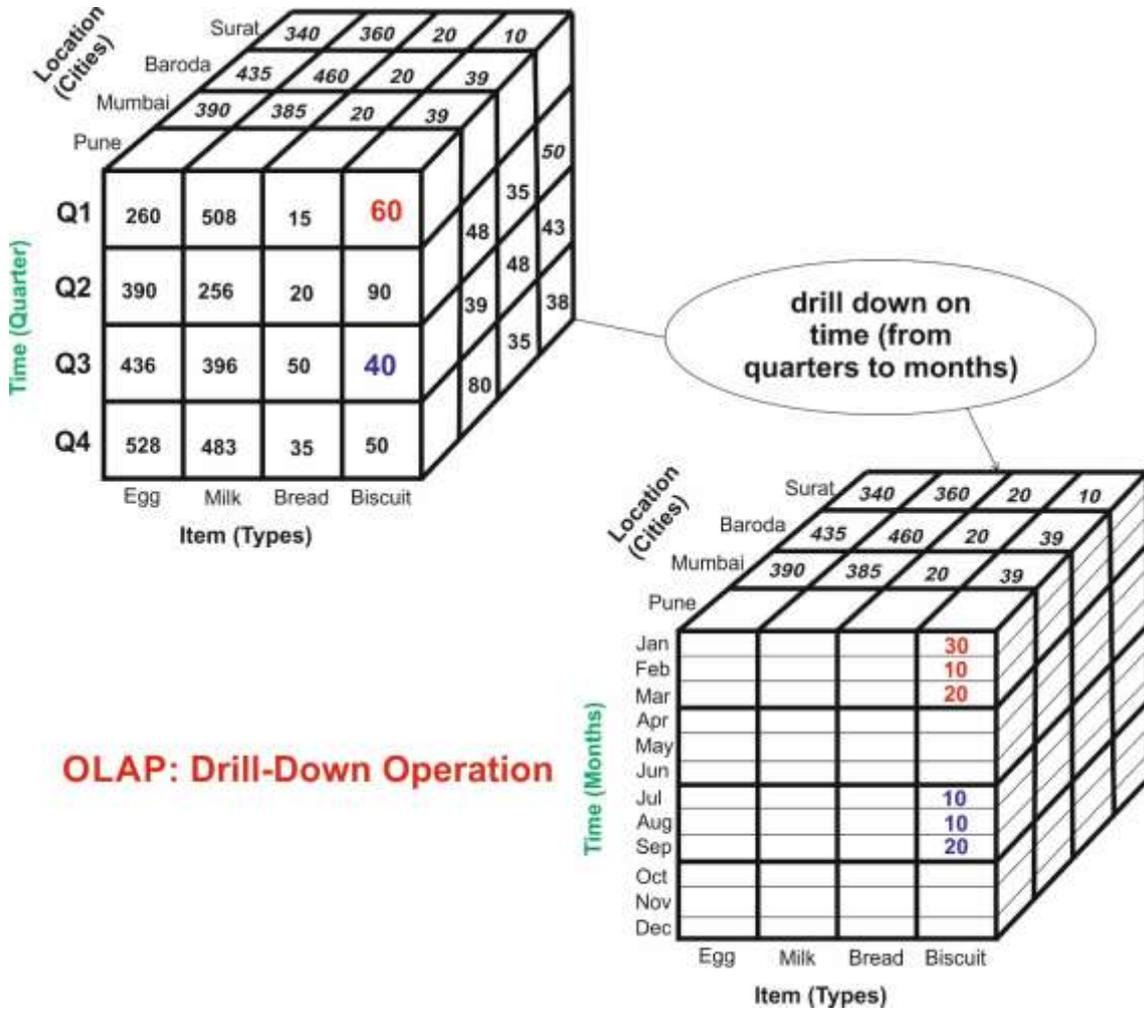
In drill-down data is fragmented (divided) into smaller parts. It is the opposite of the rollup process. It can be done via

- a. Moving down in the concept hierarchy.
- b. Increasing a dimension.



Consider the following diagram:

In this overview section, drill-down operation is performed by moving down in concept hierarchy of **Time dimension (Quarter to Months)**.



**Fig 1.3: Drill-down Operation**

In this example, Quarter Q1 is drilled down to months January, February, and March. Corresponding sales are also registered. i.e. dimension months are added.

**SLICE OPERATION:**

In this operation, one dimension is selected, and a new sub-cube is created.

In the overview section, slice is performed on the dimension **Time (Q1)**.

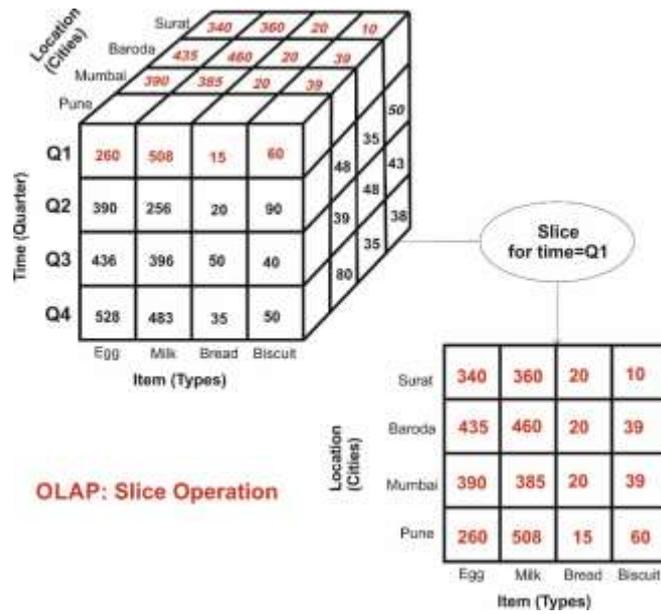


Fig 1.4: Slice Operation

In this example, dimension Time is Sliced with quarter Q1 as the filter. A new cube is created altogether.

**DICE OPERATION:**

This operation is similar to a slice.

The difference in dice is that, you can select 2 or more dimensions that result in the creation of a sub-cube.

In the overview section, a sub-cube is selected by selecting **Location Pune or Mumbai and Time Q1 or Q2.**

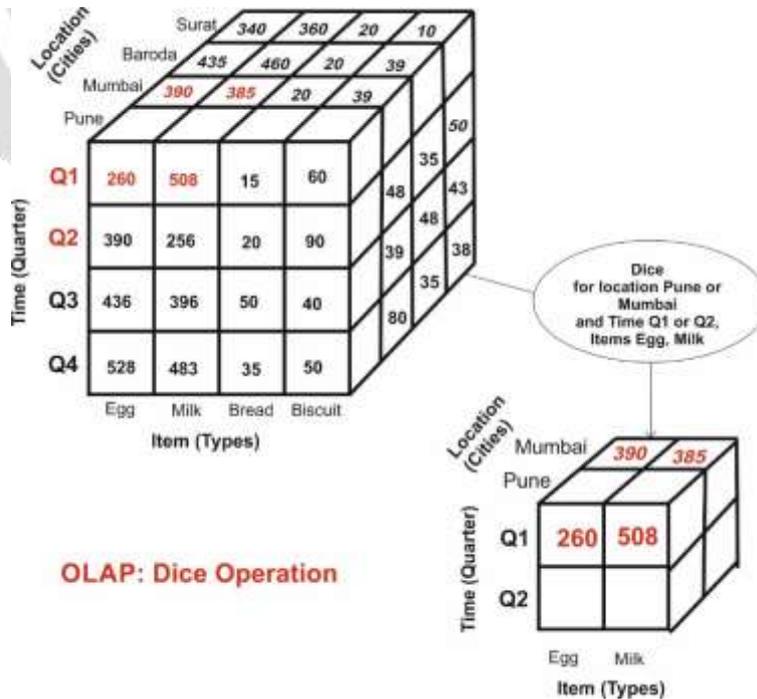
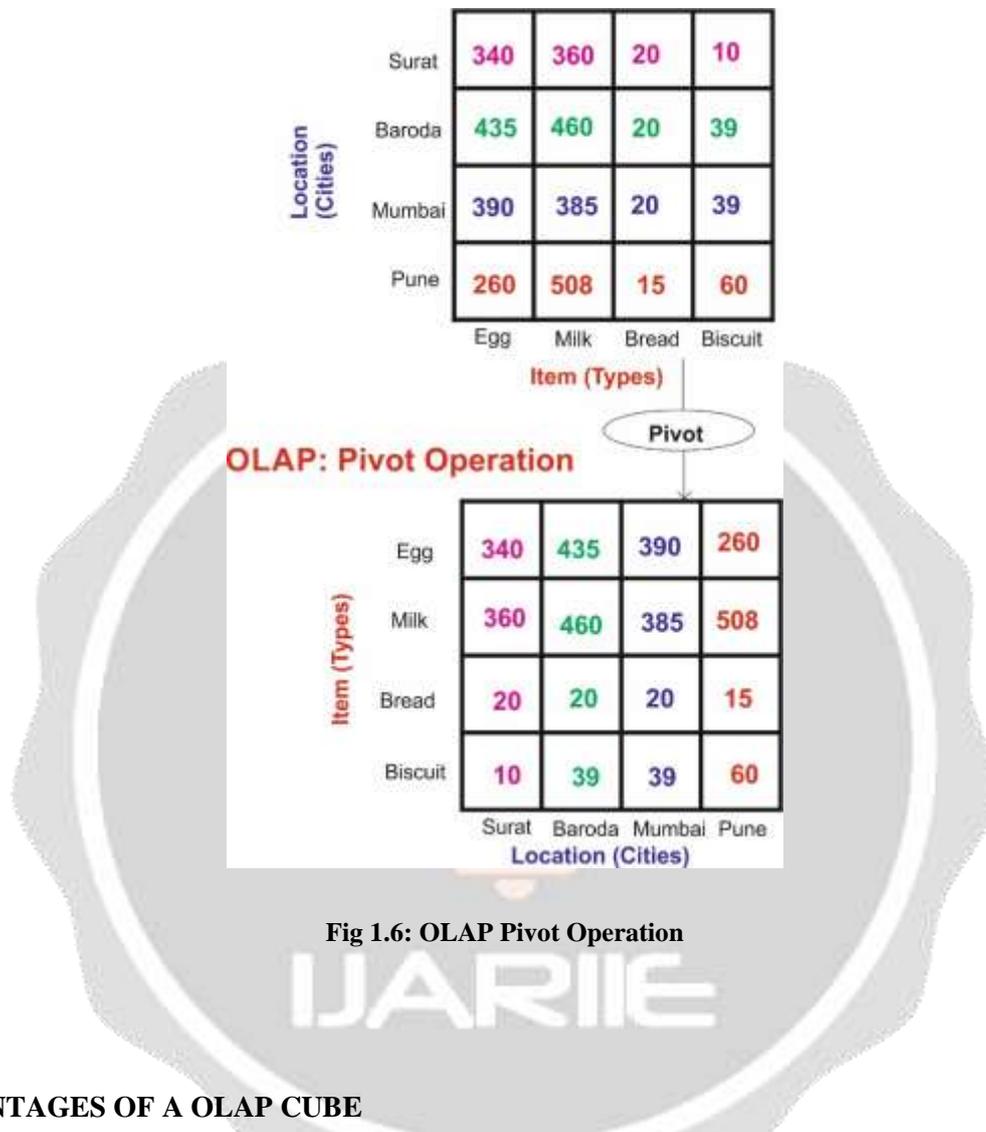


Fig 1.5: OLAP Dice Operation

**PIVOT OPERATION:**

In Pivot operation, [3] you rotate the data axes to provide a substitute presentation of data.

In this overview section, a sub-cube obtained after Slice operation performing Pivot operation gives a new view of that slice.



**Fig 1.6: OLAP Pivot Operation**

**ADVANTAGES OF A OLAP CUBE**

1. Pre-calculate and pre-aggregate [6] the data.
2. OLAP is a platform for all type of business includes planning, budgeting, reporting, and analysis.
3. Information and calculations are consistent in an OLAP cube.
4. Quickly create and analyze "What if" scenarios
5. Easily search OLAP database for broad or specific terms.
6. OLAP provides the building blocks for business modeling tools, Data mining tools, performance reporting tools.
7. Allows users to do slice and dice cube data all by various dimensions, measures, and filters.
8. It is good for analyzing time series.
9. Finding some clusters and outliers is easy with OLAP.
10. It is a powerful visualization online analytical process system which provides faster response times

## APPLICATIONS OF OLAP CUBE

### 1. Airline:

Analysis of crew assignments, flight data, flight routes, fairs.

### 2. Banking:

Analysis of customer data, transactions, loans, accounts, KYC.

### 3. Healthcare:

Generate patient's treatment reports, share data with tie-in insurance companies, medical aid services, etc.

### 4. Public sector:

In the public sector, data warehouse is used for intelligence gathering. It helps government agencies to maintain and analyze tax records, health policy records, for every individual.

### 5. Investment and Insurance sector:

In this sector, the warehouses are primarily used to analyze data patterns, customer trends, and to track market movements.

### 6. Retail chain:

In retail chains, Data warehouse is widely used for distribution and marketing. It also helps to track items, customer buying pattern, promotions and also used for determining pricing policy.

### 7. Telecommunication:

A data warehouse is used in this sector for product promotions, sales decisions and to make distribution decisions.

### 8. Hospitality Industry:

This Industry utilizes warehouse services to design as well as estimate their advertising and promotion campaigns where they want to target clients based on their feedback and travel patterns.

## CONCLUSION

OLAP cube is efficiently used to analyze the business data, helpful for decision making as data is pre calculated and pre aggregated and can be used in many sectors like education, manufacturing, banking, etc.

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