



## Business Intelligence Approach in Decision Support: Study Case on Airport Expenses and Income Analysis

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**Abstract:** *Making decisions in business or in personal life is basically the same thing. The relevance of these decisions determines the direction and effectiveness of the activities developed by the organization. To take relevant decisions the management needs relevant information and objectives of previous periods. Thus managers and entrepreneurs would be appropriate to choose to use some modern applications to streamline the decision making process, like Business Intelligence. These applications show correlations between data, makes estimations and forecasts and detects faults in data processing in a significantly reduced time. The effectiveness of these solutions, their processing and speed of obtaining the necessary information is a deciding factor in a fierce, aggressive and especially competitive environment. It is important to highlight that Business Intelligence applications cannot and do not replace people who should make these decisions, but creates a flexible and accessible framework to highlight problems or failures less accessible in a significant amount of data. Therefore they give people the ability to focus on solutions that bring a higher profit to the companies. In this paper we present and discuss a study case on Airport Expenses and Income Analysis using an OLAP Application.*

**Keywords:** Business Intelligence, Decision Support Systems, OLAP, Data Warehouse, Airport Expenses and Income.

### 1. INTRODUCTION

Any decision taken affects to good or bad a certain component of the organizational system, so the key for success lies in how decisions are made so they can bring the maximum efficiency to the organization . It is required to find the answer to questions such as: "Who makes the decisions?", "What involves an intelligent decision?", etc. First of all we intend to say that decisions are made by the persons with top management functions (CEO, manager, chairman) but things are not really like that, decisions must be made in a smart way and by all people of the organization on levels so this would lead to organization success.

Any choice that leads the organization to timely objectives can be named as an efficient decision.

It is noted that some notions have a main role in making such decisions:

- setting objectives;
- determine some sizes to measure deviations from target;
- setting deadlines to achieve objectives.

Pointing out the objectives, measure methods and evaluating models, is desired to find solutions through which the organization will obtain and deliver information underlying the decision and evaluate them [1].

Thus arises the necessity of a platform that presents accurate information, useful and representative for any of the persons involved in making timely and effective decisions. These are called Business Intelligence platforms and they are an integrate part of information systems for decision support making based on synthesis of data, especially data warehouses [9].

## Data warehouse

The dates that are used by information systems for support decisions making are called Data Warehouse. Their main characteristic is the storage capacity of the order of 10<sup>12</sup> tetrabytes, and the mining of these impressive volumes is made through special motors and some special services of on-line data analysis (OLAP).

The objectives underlying these warehouses can be divided into three steps:

- assimilation of concepts of information systems for support decision making underlying the analysis and synthesis of data;
- use of modern technologies as Data Warehousing and Online Analytical Processing (OLAP) that are used in transformation of data into summarized information;
- assimilation of techniques and multidimensional data processing methods such as: Data Warehouse, Online Analytical Processing, OLAP cube, hypercube, multidimensional database and other new technologies used in the given domain.

Data validation process made by synthesizing, analyzing and their interpretation is the process by which synthesis situations are created for decision support. For this, there are specific software, queries, total functions and subtotal given by the reports generator, etc.

Data analysis aims to identify relations like associations, structural correlations, functional or causal, between summarized data. These analyzes have led to some other analytical data observation techniques like Data Mining which combines mathematical theories. The result of the observation process is represented by patterns, models and correlations. With these results we can deduce trends and predict data for subsequent periods.

A special role in providing analysis techniques, optimization, simulation and graphical representation of the results had traditional software tools such as Lotus and Excel table processors, which works with small volumes of data or the Access database management, Visual Foxpro which works with large amounts of data.

The inconvenient with this software is that they only work on predetermined data structure from a single source while new systems use special techniques to merge data stored in non-uniform structures.

The new systems support offers facilities like: natural language queries, access to conceptual models, OLAP management systems and integration services with other software supports [6], [8]. These systems underlined on the data analysis and synthesis and can merge data, make systematizations, correlations and group information in obtaining information outlining the factors that influence positively or negatively on the organizations performances.

To summarize, the techniques for exploiting impressive amounts of data are able to suggest solutions and to contribute to decision making in various situations.

## Business Intelligence

*"Without changing the IT system, we would not be able to manage the activity efficiently. You cannot support an increase in turnover of 10 to 15 million euros with a simple accounting application."* (Bogdan Baltac, CEO Einhell Romania)

Knowledge management involves the management of information flows in securing the fact that the required knowledge get to the right people in a timely manner so that optimal measures can be taken.

Information gradually became conductor in almost all business areas. The speed of obtaining information and their processing efficiency is one of the deciding factors in a competitive and increasingly more aggressive environment as the current one.

Information management is performed using a range of processes including: Knowledge Management, Business Intelligence and Competitive Intelligence [9], [3].

Competitive Intelligence involves collecting information regarding the external business environment and turn them so that they are effective in making tactical and strategic decisions. [1]

In the internal environment, Business Intelligence is build around interdepartmental activities, material and information flow analysis and ways to improve them from inside.

Knowledge Management in the implementation process of organizational knowledge about internal and external environment seeks to apply efficiently information underlying current decisions and planning strategies regarding growth of performance [1].

Business Intelligence concept has been developed at the same time as data warehouse concepts and the completion of the process by which data analyzed are transformed into necessary information for decision making.

Business Intelligence means more than a lot of reports or a context of detailed and accurate information [9]. All these represents a solution for Business Intelligence when they are turned into an accessible format, easy to read and understand by any person at decision making levels to identify smart and effective solutions for any particular situation occurred in current activity.

The Business Intelligence solutions developed by Microsoft are based on Microsoft SQL Server 2005 [2],[7]. Some important components of the platform are: Analysis Services, Key Performance Indicators, Data Mining and Reporting Services.

Collecting relevant and important information for the company and the business itself, then their analysis and organization are Business Intelligence elements that help decision making appropriate both for some simple documents made in Excel and for using some software made for this thing.

There are two types of Business Intelligence tools:

- Reports and analysis systems like Excel used in small companies
- Reports, analysis and measure systems of company performances like OLAP (Online Analytical Processing).

According to Brandas (2007) Business Intelligence is a new vision of the organizational decision process. The BI activities are anchored on information-decision infrastructure provided by Decision Support Systems combined with

other computerized instruments for decision supporting (Data Warehouse, OLAP, Data Mining, Knowledge Management and Expert Systems) [4], [5].

### **OLAP – Online Analytical Processing**

DBMS systems cannot handle the requirements regarding aggregate data, synthesis, consolidation and multidimensional projections, this fact generating the need for some special components that will allow these requirements, like OLAP and Data Mining. The focus is on those components which are information systems for intelligent research of business based on information technologies of support decision making [6], [8].

The Data Mining techniques make possible the discovery of patterns, knowledge, less obvious models in a large amount of data using machine learning algorithms that were overlooked initially, followed by the building of some predictive models of future details.

Among the most important techniques in business research stands OLAP technique that uses various static tools to identify correlations in data sets. Using these instruments, on a large amount of data, makes possible the extracting of samples needed for the decision process like queries and reports. An example might be: "How many flights were made each month on each route?".

OLAP is a data aggregation technology stored in warehouses through a multidimensional approach [9]. It complements data warehouses by transforming data into relevant information for support decision making in an interactive and flexible way.

This is done by means of techniques which allow detailed and complex analysis of data, generating effectiveness on multidimensional databases and possibility of construction of alternatives for various decision problems.

The characteristics of this technology can be summarized in some general terms as:

- perspective of multidimensional data
- ability of computationally intensive
- orientation in time.

Multidimensional aspect of data is given by the possibility of integrating various aspects that

define an activity and which are considered from different perspectives like value, products, time.

In another context, OLAP also features a multidimensional modeling (OLAP cubes), which provides a common model across reports turning them into a uniform and flexible structure which keeps in touch with the original data source , providing the possibility of data structuring on different levels increasingly smaller.

The results of the analysis can be presented as:

- Reports
- Performance indicators
- 3D graphics
- Complex analysis of forecast and what if
- Autonomous alerts
- Classic analysis of sales, profitability
- Human resource studies
- Consumption and performance analysis.

BI has a greater economic connotation linked to managers' vision and it is focused mainly on the decision process [4]. The technical support for BI is ensured by existing technologies integrated in a Hybrid Support System (HSS) or Hybrid Decision Support Systems (HDSS) [5]. This kind of systems forms a real Business Intelligence Support System (BISS).

In the Romanian context of socioeconomic market, organizations start slowly to realize the utility of such decision programs for detection of real-time information by which can be discovered things that need to be improved in the idea of increasing profitability, reduce costs, etc.

But buying these programs must be taken seriously, especially as they have to be analyzed by specialized people to be free of facing situations where the provided image is incomplete, misinterpreted, or incorrect due to lack of expertise or knowledge of the program functionality.

## 2. METHOD AND RESULTS

### 2.1 Expected objectives

The main objective of this paper is to provide an overview easy to use and represent expenses and income arising from performing certain flights at an airport.

Based on these information, the manager will be able to establish the utility of some routes, flights; making decisions regarding the necessity to restructure routes and also flights.

Also based on these obtained information it can be establish the customer flow in and to several locations. A bigger or smaller ebb of customers with the same location can generate restructuring routes or flights in that area.

We can easily track tickets, reservations on each flight for any route and also income and expenses for each one.

### 2.2 Establish indicators

In this paper the next indicators will be considered for further analysis and obtaining results:

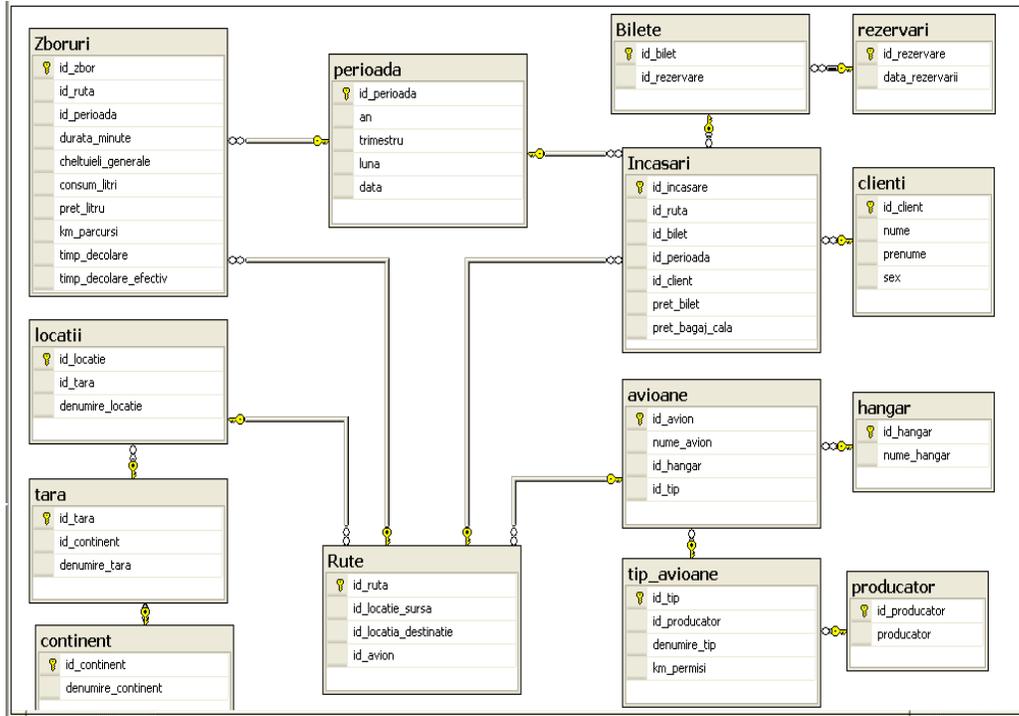
- Flights calculation on airplanes and routes
- Flights calculation on customers
- Flights calculation on routes, destinations, airplanes
- Flights calculation on destinations
- Flights calculation on each type of airplane
- Costs calculation on each type of airplane
- Costs calculation on each route and destination
- Costs calculation on each route and period of time
- Costs calculation for flights on each route
- Receipts calculation on customers
- Receipts calculation on routes, tickets, reservations, destinations
- Receipts calculation on routes, tickets, reservations and period of time
- Costs and income analysis on routes and period of time
- Income analysis compared to costs
- Reducing costs and turning them into permanent registrations
- Result calculated after changing costs
- Total costs and income recorded on routes
- Result recorded on routes

For calculating these indicators was necessary to create a database based on which the queries were made, and which later will be used in the construction of reports that will highlight certain aspects of the analysis.

The database is used by OLAP cube to supply the analysis and information whose results will help the decision making on the return of the flights performed.

The name of the relational database is AIRLINESDATA and consists of 14 tables with fields containing relevant information for a later analysis (figure 1).

**2.3 The database**



**Figure 1.** Database structure

**2.4 OLAP cube**

The cube is a structured set of organized data as a hierarchical and multidimensional arrangement. OLAP cube is a multidimensional logical model that can have various dimensions, levels of data and hierarchies of facts. In fact, it is a way of providing answers to different complex queries from databases.

- Build the connection with the database server
- Choose the source from where the information will be extracted
- Be sure that you can visualize data from the database
- Generate the cube for data
- Choose the measures and dimensions
- Make the link with the Deploy operation

Using Microsoft Visual Studio was created the OLAP cube for the previously created database in SQL Server 2005. This cube will provide easier the desired information through his indicators.

The cube has 4 dimensions (routes, period of time, customers, tickets) and 2 tables with facts (flights, receipts) from which will be extracted the measures, attributes and will be formed hierarchies (figure 2).

To load the database from SQL in Microsoft Visual Studio this are some steps that need to be followed:

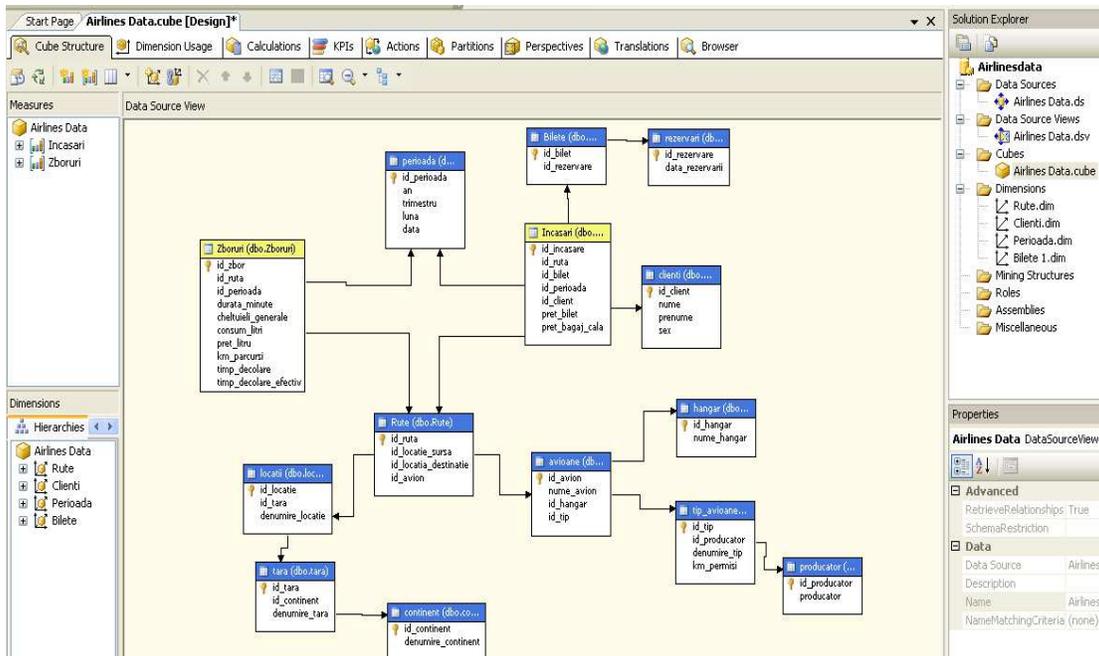


Figure 2. The OLAP cube diagram

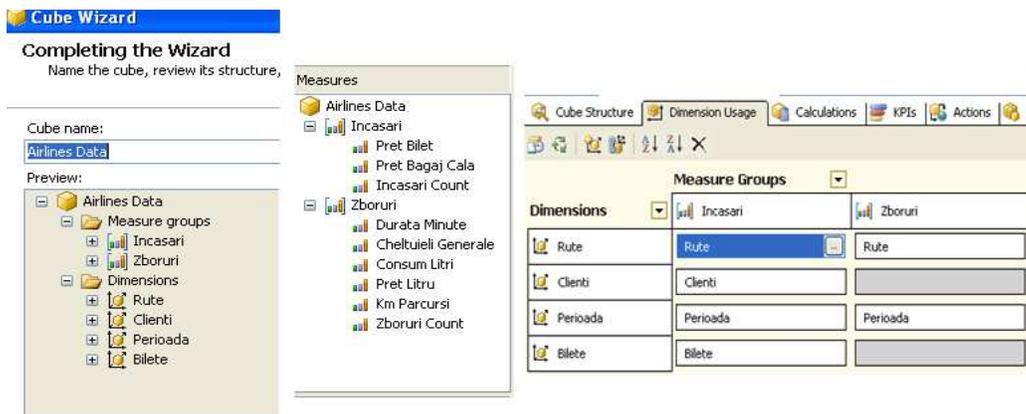


Figure 3. Dimensions and measures

The dimensions contain the characteristics of tables of facts with explicit data, but on the other hand, tables of facts are the quantifications of activities presented as measures, depending on which value will be analysed the established indicators (figure 3).

### 3. DISCUSSION

This analysis shows the distribution of costs on planes (figure 4). It is noted that the higher number of flights made by certain airplanes.

Producator - Producator		Denumire Tip Nume Avion	Zboruri Count	Cheltuieli Generale	Consum Litri	Pret Litru
Airbus	large tr	Embraer 120	1	1125	90	0.78
		Embraer EMB 110	3	2062.5	165	3.08
		Embraer EMB 121	2	1437.5	115	2
		Total	6	4625	370	5.86
	large u3		36	23312.5	1865	35.62
	largeAT-U		124	76250	6100	123.96
	largeAT-U2		18	9500	773	17.8
	u3		4	1875	150	3.6
	Total		188	115562.5	9258	186.84
	Grand Total		largeAT-U2 (Denumire Tip)		15562.5	9258

Figure 4. Costs calculation on each route and airplane

Drop Filter Fields Here									
Prodicator - Prodicator ▾   Denumire Tip/Numr Avion									
Route	Embraer EMB 110	Embraer EMB 121	Total	large u3	largeAT-U	largeAT-U2	u3	Total	Grand Total
Zboruri Count	Zboruri Count	Zboruri Count	Zboruri Count	Zboruri Count	Zboruri Count	Zboruri Count	Zboruri Count	Zboruri Count	Zboruri Count
55			3					3	3
77				4				4	4
78				11				11	11
111				1				1	1
112				2				2	2
121						3		3	3
123				4				4	4
125				1				1	1
131							1	1	1
134					2			2	2
140				2				2	2
141						1		1	1
156						1		1	1
176	1	1						1	1
177				1				1	1
188	1	1						1	1
Grand Total	2	6	36	124	18	4		188	188

Figure 5. Flights calculation on airplanes and routes

An	Trimestru	Luna	Data	Zboruri Count	Cheltuieli Generale	Consum Litri	Pret Litru	Pret Bagaj Cala	Pret Bilet
2010	t1			26	13812.5	1118	26.42	10798.47	36094
	t2			37	23687.5	1895	36.08	17845.71	59171
	t3	7		10	7062.5	565	9.52	4139.92	13950
		8	08	1	562.5	45	1.2	371.8	1318
			09	6	3750	300	6.06	3041.41	10046
			14	2	1437.5	115	2.16	1321.04	4345
			21	1	1000	80	0.78	624.19	2065
			23	1	562.5	45	0.96	684.17	2199
			25	1	875	70	0.96	324.34	1134
			Total	12	8187.5	655	12.12	6366.95	21107
		9		23	14750	1180	23.38	11890.28	39369
			Total	45	30000	2400	45.02	22397.15	74426
	t4			80	48062.5	3845	79.32	39580.91	130202
			Total	188	115562.5	9258	186.84	90622.24	299893
Grand Total				188	115562.5	9258	186.84	90622.24	299893

Figure 6. Flights and costs calculation on periods of time

The analysis shows us the number structure of flights made by each airplane on each route (figure 5). It is noted a significant number of flights on various dates and also the costs and income obtained from ticket sales (figure 6).

```

select route.id_ruta,
SUM(zboruri.consum_litri*zboruri.pret_litru+zboruri.cheltuieli_generale) as cheltuiala_totala,
SUM(zboruri.consum_litri*zboruri.pret_litru) as cheltuieli_benzina,
SUM(cheltuieli_generale) as cheltuieli_generale,
sum (incasari.pret_bilet+incasari.pret_bagaj_cala) as total_venituri,
sum (pret_bilet) as venit_din_vz_bilete,
sum (pret_bagaj_cala) as venit_din_bagaje

from
Zboruri,
incasari,
route
where Zboruri.id_ruta=route.id_ruta
and incasari.id_ruta=route.id_ruta
and zboruri.id_ruta=incasari.id_ruta
group by route.id_ruta
order by route.id_ruta asc
    
```

id_ruta	cheltuiala_totala	cheltuieli_benzina	cheltuieli_generale	total_venituri	venit_din_vz_bilete	venit_din_bagaje
1	8112.0000	612.0000	7500.00	6775.21	5229.00	1546.21
2	1602993.0000	117243.0000	1485750.00	1321796.03	1014062.00	307734.03
3	5408.0000	408.0000	5000.00	5726.24	4390.00	1336.24
4	51105.6000	3855.6000	47250.00	61146.19	46781.00	14365.19
5	15382.8000	1132.8000	14250.00	7026.72	5428.00	1598.72
6	3785.6000	285.6000	3500.00	4187.66	3218.00	969.66
7	7571.2000	571.2000	7000.00	5089.44	3936.00	1153.44
8	19463.0400	1463.0400	18000.00	7514.01	6012.00	1502.01

Figure 7. Costs and income recorded on routes

Following this evidence, the costs and income analysis on routes can be made easier (figure 7). So right decisions can be taken for the company. Based on the number of flights on routes, costs and income for each route, is noted the fact that some airplanes are not doing any flight at all, others are doing too many flights; also high costs on some routes or costs recorded by planes without income, due to missing flights. All these may alter the result.

- It should be a focus on airplanes that are not doing any flights and moving them on routes with a high flow of customers.

The result of the analysis shows the need of restructuring some routes and flights.

- It is necessary to reorganize the flights and flight frequency depending on the ebb of passengers to certain routes.
- It is necessary to eliminate those routes that are not profitable.

A set of changes has been made:

- Reduce general costs by 80% because of the reorganization of the planes with no profitable routes or with no flights by placing them on routes with a large flow of customers (figure 8).
- Also there was a reduction in fuel consumption by 10 % because of the restructuring of routes on smaller areas and with a bigger flow of costs (figure 9).

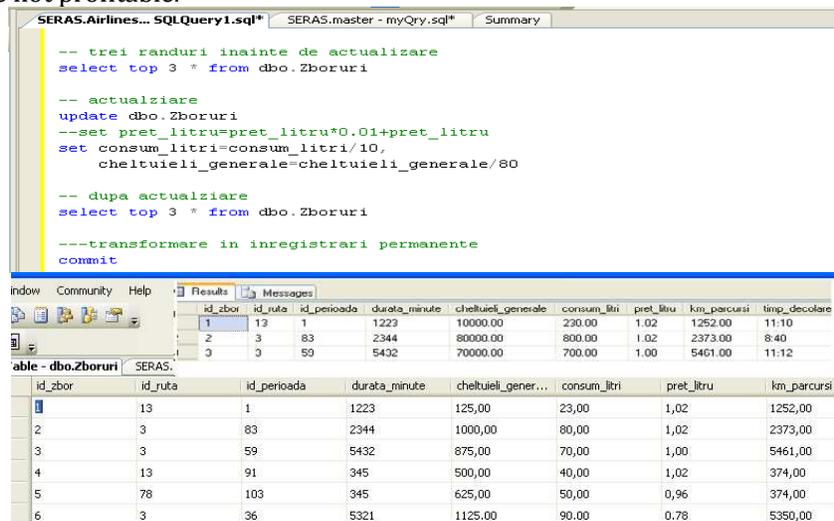


Figure 8. Reducing costs and turning them into permanent registrations

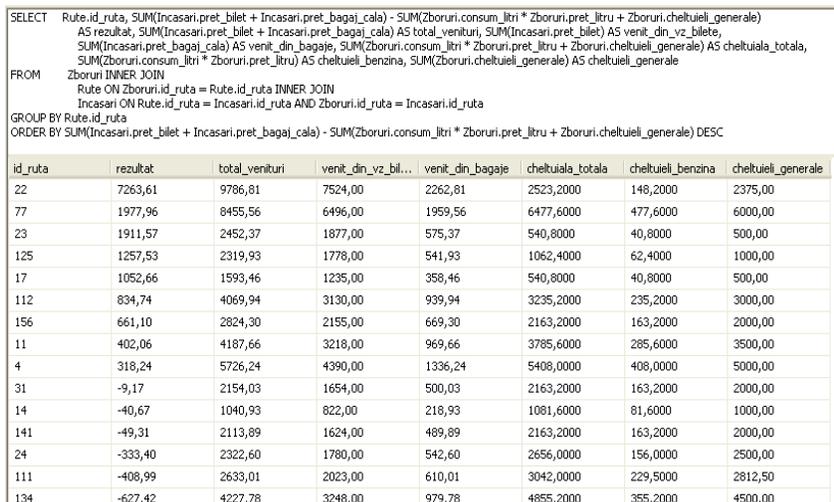


Figure 9. Result calculation after modifying costs

Based on previous analysis and decisions taken, it can be seen that the manager took the right decisions, shown by the record of results, where you can see that some routes are profitable after restructuring.

#### 4. CONCLUSIONS

Collecting relevant and important information for the company and the business itself, then their analysis and organization are Business Intelligence elements who help decision making appropriate both for some simple documents made in Excel and for using some software made for this thing.

Business Intelligence applications cannot replace people, but creates an accessible framework to highlight problems, so the people will focus on solutions that bring a higher profit to the companies.

To summarize, the techniques for exploiting impressive amounts of data are able to suggest solutions and to contribute to decision making in various situations.

The effectiveness of these solutions, their processing and speed of obtaining the necessary information is a deciding factor in a fierce, aggressive and especially competitive environment.

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